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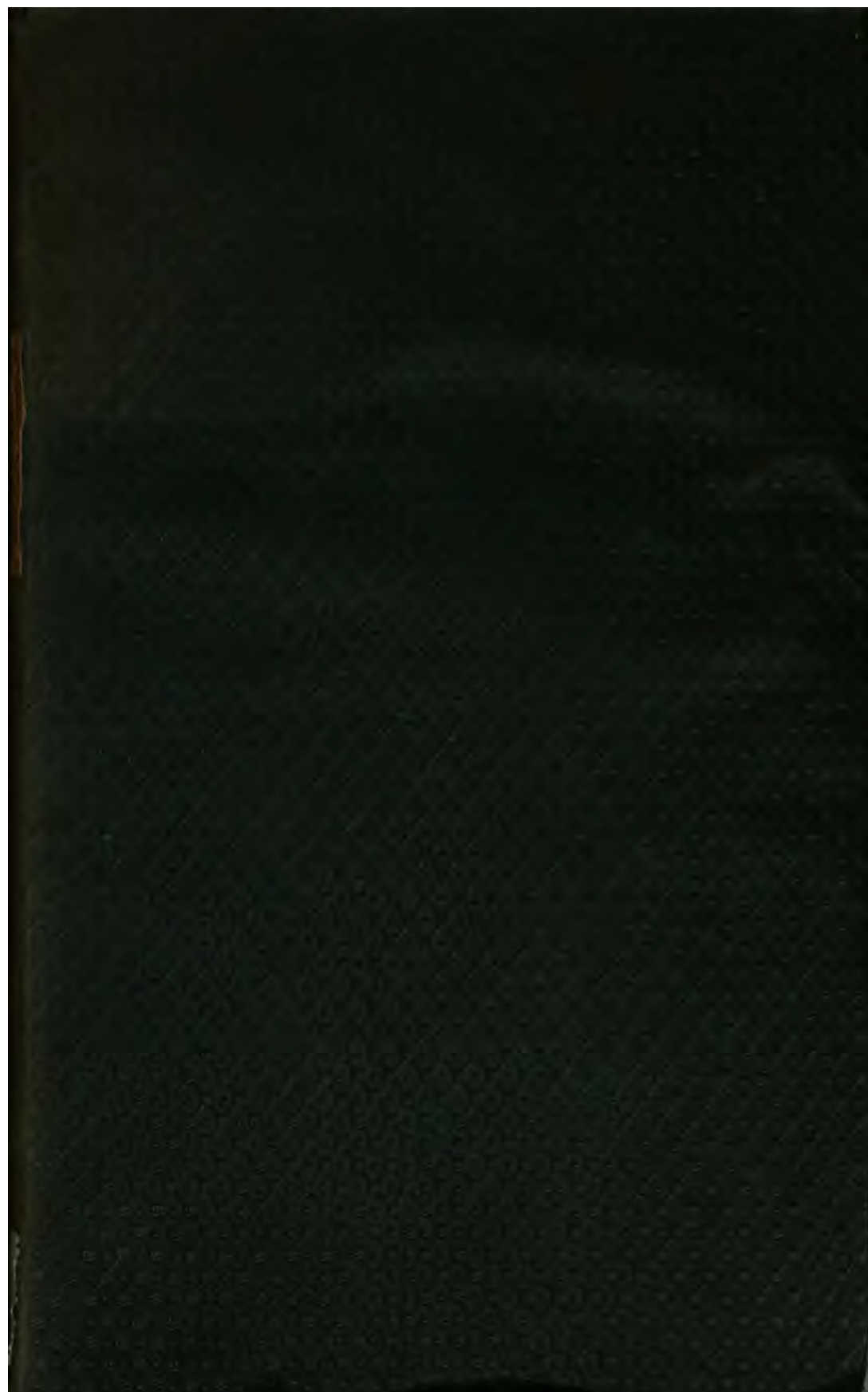
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St. 9.



GEOLOGICAL SKETCHES
AND
OBSERVATIONS,
ON VEGETABLE FOSSIL REMAINS,
&c.,
COLLECTED IN THE PARISH OF ASHTON-UNDER-LYNE,
FROM THE
GREAT SOUTH LANCASHIRE COAL FIELD,
&c. &c. &c.
ALSO,
AN ATTEMPT TO EXPLAIN
THE ORIGINAL FORMATION
OF THE EARTH,
ON A
THEORY OF COMBINATION.

Illustrated with numerous Wood Cuts, &c.

By CHARLES CLAY, M.R.C.S.E.,
ASHTON-UNDER-LYNE.

*"They still remain,
Amid the flux of many thousand years,
That oft has swept the tolling race of men
And all their laboured monuments away."*

L O N D O N :
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Manchester; and DAVIS, Stalybridge.

1839.

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**DEDICATED, BY PERMISSION,
TO THE RIGHT HONOURABLE
THE
EARL OF STAMFORD AND WARRINGTON,
LORD OF THE MANOR
OF
ASHTON-UNDER-LYNE,
WITH ALL POSSIBLE RESPECT, BY HIS LORDSHIP'S
RESPECTFUL AND HUMBLE SERVANT,
CHARLES CLAY, SURGEON.**

TO THE RIGHT HONOURABLE
THE BARRON OF
STAMFORD AND WARRINGTON.

MY LORD,

It is with feelings of gratitude I acknowledge your Lordship's kindness in allowing me the honour of prefixing your name to this little Volume of Geological Sketches.

Should it have the good fortune to meet the eye of your Lordship, it is the sincere wish of the Author that its contents may be found strictly consistent with truth, and free from the slightest tendency of injuring the noblest Institutions of our Country.

That your Lordship may long live to enjoy the fruits of the many improvements now progressing in your Lordships' estates, to the increased satisfaction of your numerous tenantry, is the earnest prayer of

Yours,

Most respectfully,

C. CLAY.

Ashton, January 1st, 1839.

PREFACE.

In offering the following observations to the notice of the public in general, the object of the author will be answered if they contribute in the least degree to the advancement of the science on which they are founded, viz., the science of Geology. Having been engaged for some years past in examining the fossil remains of his own immediate neighbourhood, the result, he has presumed, might not be uninteresting to others. In pursuing these inquiries he admits that the field of his observations has been extremely limited ; yet, while he was once perusing that beautiful little work on the natural history of Selbourne, by Mr. White, the idea forcibly presented itself that if more attention were paid by writers to such facts as came under their own every-day observation, the progress of

PREFACE.

knowledge might be more rapid, and probably much more satisfactory. This idea has led to the publication of the following pages; and if they contribute to the amusement of the general reader, or tend in the slightest degree to the advancement of geological science, the author will feel amply rewarded, and in no way regret the time they have occupied. The combined Theory which forms the concluding part of the work, may, by some, be supposed too fanciful, and therefore unworthy of general acceptance. It may be so. But when we consider that all our researches after knowledge impress our minds with views peculiar to the subject of our study, it will surely appear not unreasonable, and therefore not unwarrantable, to present those views to others, provided they do not oppose either the general laws of nature or the still more infallible guidance of that inspired communication, which is the source of all wisdom, and the basis of all knowledge. I have long dissented from the popular notion that theories retard the progress of any science, and very much question if the present improved state of geological inquiry does not owe its present importance to the indefatigable exertions of early writers in searching for and ascertaining facts in support of

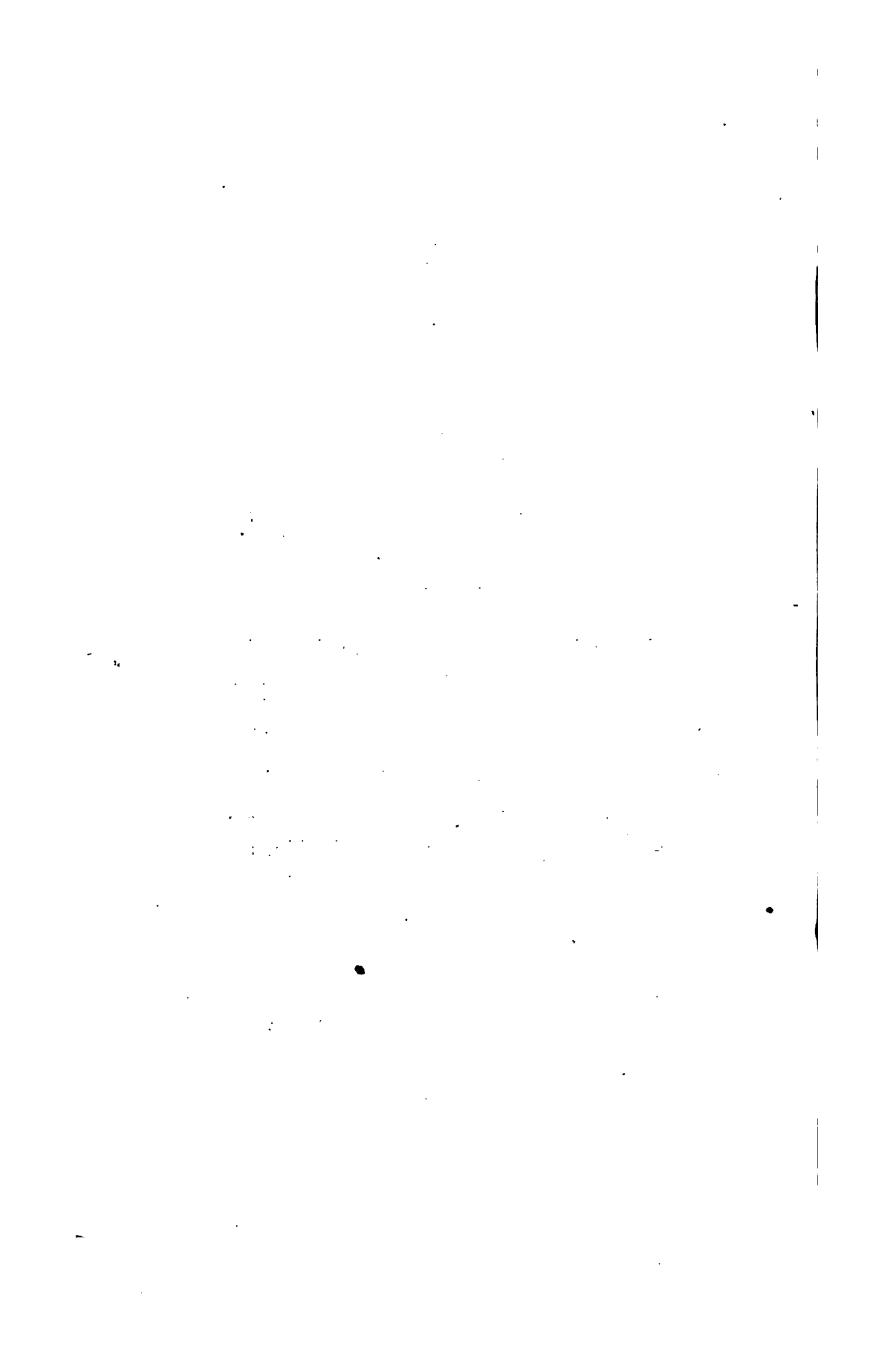
PREFACE.

some particular theory. It has been too often the fault of public teachers in chemical philosophy, to treat with contempt and ridicule the exertions of our fore-fathers in chemical science, for their visionary pursuits after the philosopher's stone; while it must be evident to every reflecting mind that it is mainly owing to the facts developed in that search that chemistry occupies its present eminence in the list of sciences. That the work may come within the means of many, and especially of those to whom the substance of it has already been addressed at the conclusion of short courses of lectures on popular geology given at Mechanics' Institutions, the author has contented himself with presenting plain outlines in wood, as illustrative of some interesting relics of those "other days," which have long been erased from the records and contemplation of man. I have endeavoured to render this work as generally applicable as possible, by freeing it from technicalities, a plan which I have invariably followed in my lectures, preferring rather to entice and thereby increase the admirers of the interesting science of geology, than retard its progress by intermixing technicalities when the subject admits of an easy explanation in plain language.

EXPLANATION
OF THE
LITHOGRAPHED PLATE.

*Figures 1, 2, 3,—*Are similar to the outlines of the same vegetables as described in the following Work. These figures are finished with greater care, to give the Reader some idea of the beauty of those relics of former ages.

*Figure 4,—*Is a beautiful specimen of Laminar Coal, the plates being extremely thin, and every fresh surface exposed exhibiting finely polished circular spots which appear luminous in the mines.



GEOLOGICAL SKETCH OF THE PARISH OF ASHTON-UNDER-LYNE.

"To me be nature's volume broad displayed,
And to peruse its all instructing page my sole delight."



EXPLANATION OF THE ANNEXED OUTLINE.

- | | |
|---|--|
| <p>O Ashton Moss Land,
I Reservoirs,
II Hills,
III River Tame,
4 River Medlock,
V Town of Ashton,
VI Town of Stalybridge,
VII Village of Lees,
S Coal Shafts,</p> | <p>I* Bardsley Rock,
II* Edge Fold do.,
III* Black Rod do.,
IV* Up Holland do.,
V* Parbold do.,
VI* Haslingden do.,
VII* Mill stone-grit do.</p> |
|---|--|

The parish of Ashton-under-lyne is situated at the south-eastern extremity of the county of Lancashire, immediately under the line of the Yorkshire and Derbyshire hills, from which most probably the addition of the latter part of its name originated. Ashton is at the extremity of an extensive plain, including the greater part of South-Lancashire. By far the most important feature of this parish is, in a geological point of view, the vast coal deposit, to which may be attributed in a great measure the prosperity and affluence of the neighbourhood. This deposit is a portion of that widely extended coal formation called by some geologists "The great South-Lancashire," and by others, "The great Derbyshire and Lancashire coal field." This coal field commences in the north-western part of Derbyshire, and from thence to the south-western part of Lancashire, forming a figure somewhat resembling a crescent with the populous manufacturing town of Manchester in the centre, the span of its extreme points being about forty miles.

The southern portion of the parish is bordered by the county of Chester, and is watered by the river Tame, which falls into the Mersey at

Stockport, about seven miles distant. (Marked III in the outline of the parish.) The northern portion is watered by the tortuous and rocky-bedded stream termed the Medlock, (marked 4.) which flows from thence through Medlock-vale to the town of Manchester, where it joins the Irwell, which also falls into the Mersey.

At the southern extremity of the parish a large peat formation extends over a space of two hundred acres. There are evident proofs, however, that this bog has at some former period extended over a surface three or four times the extent which it now occupies. In excavating some foundations for rebuilding houses in the very centre of the town of Ashton in 1833-4, it was found necessary to cut through a layer of peat three feet in thickness and three or four feet from the surface; a similar appearance presented itself a short time ago when laying the foundation of a factory situate below the town, on the bank of the Peak Forest canal, and near to the river Tame. This peat formation (marked 0) is at present undergoing considerable change from cultivation, and has already begun to repay the lord of the soil in some parts for the great trouble and expence he has bestowed upon it. I have long been of opinion that the

system of draining pursued for converting peat bogs into cultivated land is ineffectual, from the great tendency of the drains to run up, and the expence required to keep them in order. The plan I would suggest would be, to cut through the peat a circular opening, then, by the protection of a wooden shield, raise the marl from beneath and replace the peat, thus making an opening into the porous strata beneath, which if repeated three or four times in an acre would be ample and perpetual drainage; by replacing the peat and spreading the marl on the surface thus, three great objects would be gained—1st, draining the land,—2nd, manuring on the spot—3rd, an extra supply of water to the springs in the vicinity, so valuable in manufacturing districts. The average thickness previous to the draining of this moss was from five to six feet; but the present average will not be more than from three to four feet. On making a section of this formation the first eight or ten inches are found to be of a lightish brown colour and of a very spongy texture, then about two feet of dense black peat, and lastly from eighteen to twenty inches of trunks of trees beautifully preserved, though no record can trace their entombment. The trunks of this timber are laid nearly horizontal, many of which

are twelve inches in diameter. Their direction is from north-east to south-west, that is, from the high land to the lower land of the parish. This appears to confirm the idea that this peat bog has at some remote period suddenly been removed from a more elevated site, and in its progress overwhelmed this forest, which most probably gave sufficient resistance to determine its present situation. I think many peat bogs in low grounds owe their present situations to the same cause, and perhaps a distinction should be made between bogs retaining their original site of formation and those that have moved from elevated lands to other sites, in consequence of being checked in their progress by large forests. The timber under this formation is chiefly birch; and though the substance of the wood is converted into a mass as black as ebony, yet the bark retains that silvery whiteness for which it is remarkable in the pride of its growth. The texture of this wood is entirely destroyed; for though at first it appears firm and fit for cabinet furniture, yet after a little exposure it falls to pieces and is rendered useless. It ignites easily, and burns with a bright flame.

The atmosphere of the parish of Ashton-under-lyne is cold and generally moist in character;

the coldness of course arising from its elevation, being at least one hundred and fifty feet higher than the town of Manchester, six miles distant; and its moisture from its immediate vicinity to the Yorkshire hills, from which the clouds rebound and let fall their rain on this parish.

The soil is generally stiff and unyielding. It is therefore not very productive unless great attention is paid to its cultivation. This parish being situate in a densely populated district there is but little of its space uncultivated, and that is in the north-east or high land of the parish, called Boardman's Edge, Hartshead, Top o' the Heights, and Height Birches. (Marked II in the map.) This is all which remains uncultivated, with the exception of the moss (O) already described.

The parish is highest in elevation at its north and north-east sides, declining gradually to the plain of South Lancashire; its lowest sides being at the south and south-western points. The highest land in the parish is not more than eight hundred feet above the level of the sea.

There are nearly twenty shafts at work for raising coal in the parish, (which are marked 8

in the map, besides others in the vicinity, which add considerably to the wealth and enterprise of its inhabitants.

In the high lands of the parish boulder stones are found of almost every description, of the older series of rocks such as granite, porphyry, limestone, &c.

From the western side of the parish towards Lancashire the stratified rocks gradually crop out in a north-easterly direction towards Yorkshire. These rocks are very numerous, and present a variety of appearances from the Bardsley formation down to the higher mill stone grit, with seams of coal between. The first rock which shows itself within the boundary of the parish is the Bardsley Rock, passing under the western part of the parish, and may be examined easily at Bardsley bridge on the Oldham road, over the Medlock, about a mile and a half from the town of Ashton. (See map I*) The average thickness of this formation is about eighteen yards, when hewn into blocks for building it has a very white appearance if raised from the lower beds of the formation, but if from the upper layers it is marked with innumerable spots of fossil vegeta-

ble remains, in which this formation abounds to a very considerable extent. The ease with which this rock is worked is a proof of its soft texture ; though used for buildings in the immediate neighbourhood its qualities are not thought so highly of as to ensure its being fetched from a distance. Buildings when first erected look extremely white ; in time, however, it assumes a dirty reddish yellow tinge, probably from the oxides of iron.

I have already said that it abounds with fossil vegetable matter and these are chiefly the leaves and seeds of plants ; some of the seeds in my possession are quite perfect, while others appear just bursting into vegetation.

According to Looney the following are found fossilized in this formation—

Trigonocarpum noggerathi,
Calamites nodosus,
 *mougeothii*,
 *approximatus*,
 *cannæformis*,
Palmacites noggerathi,

and in the shales below this formation a variety of the fern tribes present themselves—in the alluvia above this formation have been found

large quantities of hazel nuts beautifully preserved, three or four feet from the surface, some of which appear to be approaching a state of fossilization. In the excellent map of Elias Hall, of Castleton, this rock is marked No. 18; no person who wishes for geological information in the various counties of Lancashire, Derbyshire, Cheshire and Yorkshire should be without this map, which for general correctness cannot be surpassed, and will no doubt be highly valued long after the author is gathered to the tomb of his forefathers.

In this little work I shall generally apply the same names to the rocks and seams of coal as Mr. Hall, because he has already hit upon the plan of naming according to terms given them in the localities where the rocks crop out or the mines are worked, a plan which must be attended with infinite advantage to the inquirer; this Bardsley Rock is marked I* in the map. Following the Bardsley formation a number of rocks present themselves. The Fox holes rock, fourteen yards thick; Blend rock, nine yards thick; Great Mine, three yards thick; Trencher Bone rock, twenty yards thick; Hard Mine rock, eight or nine yards. Between these seams of coal are found; in the shales

and in the rocks intervening, are similar fossils to the Bardsley formation, but not near so numerous nor so well defined.

The next principal rock is the Edge Fold, or Hunclyff rock, (marked II*,) termed by some Lump rock, from the irregular masses into which it breaks and whenever it crops out gives a peculiar rugged wildness to the scenery on the surface. This may be observed at the weir of Dukinfield, on the south border of the parish; a pretty specimen of this is seen also at Arden Mills waterfall, four miles from Ashton, down the course of the river Tame:

This rock is marked 12 in Hall's map, and is of but little use as a building material, from the difficulty attending the working of it into shapely blocks. It is however a very compact and durable formation, and it is frequently found in the rough walls of very ancient buildings (Ashton Old Hall is an example) mixed with the more pliable stone of other formations. Its average thickness is twenty-one yards. In addition to the fossils of the Bardsley formation we also find the

Trigonocarpum ovatum,

Lepidodendron obovatum and *noggerathi*,

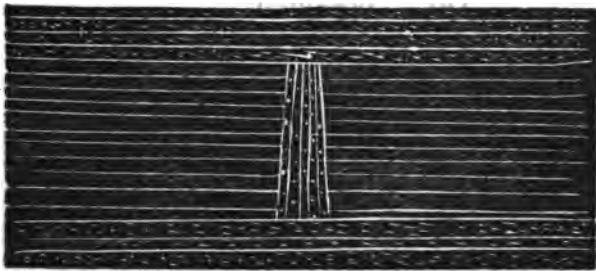
Sigillaria pachyderma,
Sigillaria reniformis,
 Palmacites and Ferns.

In the shales beneath are found the

Sphenopteris crenata,
 Do. *latifolia*,
 Do. *caudata*,
Pecopteris nervosa,
Halonia gracilis,
Knorria taxina,
Pinus anthracina,
Calamites verticillatus,
Sphenophyllum erosum,
Asterophyllites tuberculata,
 Do. *grandis*,
Lepidostrobus variabilis,
Sigillaria pachyderma,
 Do. *reniformis*,
 Do. *alternans*,
 Do. *organum*.

Following the Edge Fold is the Blackrod or Oldham rock, (marked III*,) with the exception of a ten yard rock intervening. The Oldham or Blackrod Rock, marked No. 10 in Hall's map, averages twenty-seven yards in thickness, and makes its appearance in the parish at Small Shaw, Alt, and north of Glodwick fault. This

formation is often mistaken for the new red sand stone, it is remarkably rich in fossil vegetable objects of extraordinary size. The *Calamites cannæformis* has been found sixteen feet long and the diameter little altered; of *Calamites* there are three or four varieties, *Sigillaria* four varieties, *Halonias tortuosa*, and *gracilis*; *Favularia tessalata*, *Trigonocarpum*, *Stigmara ficoides*, &c. Two other strata of similar formation, above the Up Holland rock, contain a vast variety of fossils, many of which are extremely beautiful; in some instances the stems are contrary to the inclination of the strata and composed of fine grained sand stone, while the matrix is indurated clay; Mr. Looney has remarked that when these fossil stems are erect they never penetrate through more than one strata, disappearing as soon as it comes in contact with another of different composition, thus.



The Blackrod rock is a useful walling stone

and often used for more important buildings, it soon becomes coated with a brown colouring matter, which gives it a disagreeable appearance.

The Up Holland flag rock, (marked IV*,) the most generally useful of any rock in the neighbourhood for flags and slate, &c., makes its appearance at the western boundary at Stalybridge, and averages fifteen yards in thickness. Its fossils consist of a few of the *Sigillaria* *Trigonocarpum* *Stigmaria* *Calamites*, &c. It was in this rock a *Stigmaria* was found twenty-four feet long, twelve and a-half inches in diameter, and laid across in the strata the bark converted into beautiful coal; an idea may be formed of this fossil by referring to the general section in Hall's map where a sketch is made of this vegetable in this formation.

Near to Hartshead Pike at Brown edge, a quarry is open of coarse Sand Stone, for the purpose of grinding down into white sand for domestic use; the loose blocks thrown up from the quarry have a beautiful appearance, at first sight the blocks appear printed over with vegetable fossil impressions, but on examination no impressions of vegetables are found, but a beautiful va-

riety of crystals of the black oxide of Manganese, from the smallest to very large foliated crystals, oozing from the fissures of the rock and spreading upon the first flat surface they can arrive at.

Parbold Rock (marked V*) is seen at Mossley, north-east division of the parish, in which the *Lepidodendron*, *Sigillaria*, and *Stigmaria*, are found.

The Haslingden flag rock is an extensively useful material and may be examined near Mossley, the fossils chiefly found are the

Lepidodendron obovatum,

Sigillaria pachyderma,

..... *reniformis*,

Favularia tessalata, &c., &c.

This rock averages upwards of fifteen yards in thickness.

At the extreme eastern limits of the parish the higher Mill Stone grit approaches the surface, (marked VII*,) and is worked in quarries at Staley Wood, out of the parish; in this rock the *Lepidodendron obovatum*, *Sigillaria* and *Calamites* are found, some of which are very beautiful. This formation is about thirty yards, on the average, in thickness. As a build-

ing material this formation is very durable and much better than the lower Mill Stone grit, being composed of smaller grains and having less quartz crystals in it.

In the superficial gravel formations, on the eastern side of the parish, some small remains of mammalia are found ; teeth of the ox, deer, &c. and the vertebræ of others are occasionally found.

The north-eastern division of the parish begins to exhibit those signs of wild character connected with the lower formations when they crop out.

In the neighbourhood of Bardsley, called Lime Hurst, the springs have a tendency to deposit the Carbonate of Lime and form incrustations, but so slowly as scarcely to be worthy of particular notice.

The parish of Ashton-under-lyne, from the first development of the Bardsley formation to the foot of the Higher Mill Stone grit, comprises a section equal to one thousand two hundred and fifty-six yards. The coal seams themselves comprise no less than one hundred and thirty-five feet when combined together, and the

number of seams are about fifty—not including many which are too small to be worked with any advantage.

Through the south end of the parish, and in the direction from east to west, an immense deposit of sand presents itself, in some places fifteen yards thick, and is intersected by thick veins of silt or consolidated mud, having an appearance of being deposited at different periods ; it appears also probable that the course of the river Tame, at some remote period, was more northward than at the present time and these sand banks were produced on the original course of the river, since which the southern portion of the parish has been considerably elevated.

In order to give the reader some idea of the district, I have subjoined an extract of a section, altered a little from Mr. Hall's, of the various strata between the Bardsley formation and the Mill stone grit. The names of the rocks and mines are such as they are known by in the districts, and of course will be of more use to the party who may be inclined to search for geological treasures.

SECTION OF ASHTON DISTRICT.

Rock.	Yards.	Loose Material.	Yards.	Mine.	Feet.	Inches.
... Bardsley ...	... 17	...	...	Woodhouse's ...	2	9
... ..	...	...	...	...	...	...
... ..	...	...	40	...	...	...
... Park ...	... 19	Loose material	...	Park	2	4
... Fox Hole ...	... 14	...	...	...	...	...
... ..	...	...	...	...	...	...
... ..	...	...	...	Fox Hole	2	6
... ..	...	do	14	...	...	...
... ..	...	...	...	Cannell	2	...
... ..	...	do	20	...	...	...
... ..	...	...	...	Aqueduct	2	...
... ..	...	do	48	...	...	...
... ..	...	...	...	Little	2	...
... ..	...	do	24	...	...	...
... ..	...	...	...	Sod	4	...
... ..	...	do	10	...	...	...
... ..	...	...	...	Topaz	2	3
... ..	...	do	15	...	...	...
... ..	...	...	...	Jet amber	2	8
... Blend	... 9	...	...	...	...	...
... ..	...	do	20	Blend	...	...
... ..	...	...	...	...	3	...

Rock.	Yards.	Loose Material.	Yards.	Mine.	Feet.	Inchs.
Do.	3	...	...	...	...	...
...	...	Loose material	28	...	...	...
...	...	...	...	Great	6	...
...	...	do	23	...	...	...
...	...	...	...	Roger	4	2
...	...	...	...	Furnace	1	8
...	...	do	19	...	...	...
...	...	...	...	Dubble	2	10
...	20	...	...	...	...	...
Trencher Bone	...	...	...	Old Colonel	4	...
...	...	do	24	...	...	...
...	...	...	...	No name	1	8
...	...	do	5	...	...	...
...	...	...	...	Hard	6	...
...	...	do	6	...	...	...
...	...	...	...	Cook's Folly	3	...
Edge Fold	22	...	...	...	...	...
...	...	do	12	...	...	...
...	...	...	...	Mary	3	1
...	...	do	16	...	...	...
...	...	...	...	Town lane	3	9
...	...	do	8	...	...	...
...	...	...	...	High shuttle	2	...
...	...	do	28	...	...	...

Rock.	Yards.	Loose Material.	Yards.	Mine.	Feet.	Inches.
..	..	..	..	Lower Shuttle	1	10
.. New	..	.. do	.. 10	..	..	..
..	38	..	..	..	..	..
..	..	..	..	Spring	1	10
..	..	.. do	.. 20	..	..	..
..	..	..	..	Ox Row	4	..
..	..	.. do	.. 12	..	..	..
..	..	..	..	Old Man	4	6
.. Black Rod	32	..	..	..	..	..
..	..	.. do	.. 44	..	..	..
..	..	..	..	Little	2	..
..	..	.. do	.. 16	..	..	..
..	..	..	..	Blend	3	..
..	..	.. do	.. 6	..	..	..
..	..	..	..	Salt Petre	6	..
.. Salt Petre	6	..	..	..	..	..
..	..	.. do	.. 6	..	..	..
..	..	..	..	Smithy	2	6
..	..	.. do	.. 17	..	..	..
..	..	..	..	Foot	1	1
..	..	.. do	.. 13	..	..	..
..	..	..	..	Black	4	6
..	..	.. do	.. 44	..	..	..
..	..	..	..	Siddam	1	8

Rock	Yards.	Loose Material.	Yards.	Mine.	Yards.	Inhab.
..	..	do	24	.. Stone	.. 2	.. 3
..	..	do	5	.. Cannel	.. 2	.. 4
.. Peacock	2	..	..	.. Peacock	.. 2	.. 6
..	..	do	6	.. Sam Neely	.. 2	..
..	..	do	21	.. Water	.. 1	.. 4
..	..	do	22	.. Not named	.. 1	.. 3
..	..	do	16	.. Lees	.. 3	.. 9
.. Up Holland	15	..	..	.. Hurst	.. 3	.. 4
..	..	do	20	.. Woody	.. 2	..
..	..	do	80	.. Woody 2nd	.. 2	.. 3
.. Austerlands	34	..	..	.. Not named	.. 1	..
..	..	do	15	.. Not named	.. 2	.. 7

Rock.	Yards.	Loose Material.	Yards.	Mine.	Feet.	Inchs.
Gorshall . .	9	...	...	Not named	2	3
. .	..	...	...	..	..	..
. .	..	do	60	Not named	1	..
. .	..	...	..	..	..	..
. .	..	do	60	Rabbit	2	..
. .	..	...	..	..	..	..
. .	..	do	60	..	..	..
. .	..	...	..	King's banks, 1 & 2	3	4
Haslingden . .	20	...	..	..	..	..
. .	..	do	60	Not named	4	..
. .	..	...	..	..	..	..
Higher Mill Stone . .	30	...	..	..	..	..

FACTS ASCERTAINED DURING THE SEARCH
FOR FOSSILS.

In consequence of having resided during the last sixteen years in the parish of Ashton-under-lyne, and having had frequent opportunities of conversing with the miners and examining the fossil productions of the coal and sand stone formations, I have been induced to make a few observations while engaged in collecting the specimens which have fallen in my way, and which might, I thought, be interesting not only to the geological inquirer but also to the minds of the public in general. In this examination the miners themselves lent me considerable assistance; and though they are similar in character and deportment to most others of the same rank and of the same habits, yet I generally found them glad to give every necessary information, and pleased to find persons willing to descend with them into their subterraneous caverns, in search of those things which they themselves would have overlooked, or thought of no consequence. I take this opportunity also of thanking many of the overlookers to the mines who have lent me much valuable assistance, and to whom I am indebted for some of the most interesting fossil objects I possess, in

procuring which they neither spared time nor trouble.

Derbyshire is particularly abundant in fossil remains, and has been considered by many geologists as the principal fossil depository in the united kingdom. This opinion, which I conceive to be an erroneous one, has originated in a great measure from the facility with which collectors have obtained a great variety of specimens, which are there abundantly scattered on or near the surface of the ground. I feel confident, however, that many other districts would be found equally productive if perseveringly examined, and I hope the search which I have made in my own parish will, besides confirming this statement, lead to similar investigations in districts where no strict search has hitherto been made.

The existence of fossils, evidently the remains of animals and vegetables which at some remote period were certainly possessed of life, is now so abundantly confirmed, that it is placed beyond contradiction; every museum in the kingdom having more or less decisive proofs of this fact. And that coal itself has its origin in the vegetable kingdom seems equally well authenticated.

In further confirmation of this opinion it may be remarked, that upon all the vegetable impressions a thin coating of bituminous or coaly substance has been found, and which had to be removed in order to ascertain the precise nature of the relic impressed on the shale. This thin layer of bituminous matter I consider to be a portion of the original vegetable so changed by a chemical process of long duration as to assume its present character. This is very apparent in some of the grass blades found in a fossil state in sand stone, and which have the appearance of black stripes, while the rock itself is of a whitish grey colour. Some time ago the trunk of a tree of considerable size was found in a stone quarry on the Cheshire side adjoining this parish; which trunk was placed in an oblique position contrary to the inclination of the strata in which it was bedded in the Up Holland rock. The outer crust was about the sixth of an inch in thickness, and of the nature of coal of the best quality; this, it was presumed, was the original bark, while the inner wood was pretty nearly of the same character as the rock surrounding it, the outline, page 39, gives some idea of it. From this fact it would appear that the bark and leaves of trees are more easily converted into a coaly substance than the wood

itself, and throughout the whole of my searches this has been fully borne out. This also connects itself with another fact, that the great majority of fossil vegetable remains found in the coal strata, or more properly speaking in the shale, are those of barks, stems &c., forming near four-fifths of the whole; they are also most acute in their outline, and consequently most interesting to the collector of geological specimens. The coal strata in the parish of Ashton is remarkably prolific in vegetable fossils. Their number is so great that I have obtained a very extensive variety possessing different characters. These vegetable fossils have been found at considerable depths, varying from 150 to 1000 feet from the earth's surface. Vegetable appearances are not found in every strata; some shew not the slightest trace of them, while others exhibit them in great variety, and, with regard to the delicacy of their outline, in a most beautiful state of preservation. It appears also that the thinnest veins of coal are, in general, the best preservers of vegetable remains. In the mines most productive in fossils one remarkable fact presents itself, viz.: where the mine is disposed to a horizontal line we find these relics very imperfect, or scarcely distinguishable; but, where the mine takes upon a quick inclination, or

what is termed "a dip," the fossils are found both abundant and very perfect. In explanation of this phenomenon it may be observed, that though water is the principal agent perhaps in preserving the impressions of vegetable forms to future ages, yet where it is prevented from running or draining off freely after the object of fossilization is accomplished, it tends to obliterate the very forms it would otherwise have preserved. We find, therefore, the greatest number of fossils in mines which have considerable dip or inclination, and where the water has an opportunity of draining freely away.

The depth of the coal strata is no guide whatever to the finding of vegetable fossil matter, though some have supposed it to be so. On the contrary, they are frequently found in one mine, while in the mines above and below they have been entirely obliterated. In general, however, the thinner the mine and the greater the inclination, the more abundant and perfect are impressions found.

Vegetable fossils are found in the shaly substance in the roof of the mines. The character is preserved in the shale, and though it is pretty hard, no doubt exists that at some former period it was a pulpy or almost a fluid consistence,—a

state absolutely necessary to preserve the delicacy of the vegetable outline. I have not seen any decided vegetable impressions in the coal itself, with the exception of a species of star, an outline of which is given in the following pages under the head of a supposed flower, but which in my opinion owes its origin to a very different cause, as I shall hereafter explain. Fossil remains are frequently found in the nodules of iron-stone and in sand-stone. The specimens discovered in the former stand pre-eminent for beauty and correctness of delineation ; but the shale is by far the most prolific, where we mostly find barks and the grasses ; while the nodules produce most leaves, seeds, and fruits. In sand-stone we find barks, few seeds, but many leaves and stems.

That a mysterious chemical process is the cause of these remains there can be no doubt ; but whether this process be slow or quick we are utterly unable to ascertain. To a long process of chemical action barks and seeds offer no particular opposition ; but the short-lived and tender nature of many plants of a succulent kind, the pulpy nature of fruit, and the still more delicate outline of flowers, which some have supposed to have been fossilized, render any

long chemical process extremely improbable.

My own experience has not yet enabled me to discern any thing in these relics which might warrant the idea of their having been tossed to and fro, or removed from one situation to another at an immense distance. On the contrary, the completeness of their outlines, their unbruised state, and their most delicate fibres remaining uninjured, lead me to suppose that the plants found fossilized are in the locality of their once animated existence ; and the only contradiction to this is the difference of climate now existing in that locality, and quite at variance with the growth of vegetables of a similar class at the present period.

Of the different classes of vegetable matter I have found

Barks.....	very numerous
Leaves	numerous
Seeds	not so numerous
Stems	abundant
Roots	rare
Fruit.....	scarce
Flowers	doubtful.

The chemical process is attended by different

results in the same vegetable production. For instance, in many stems we find the

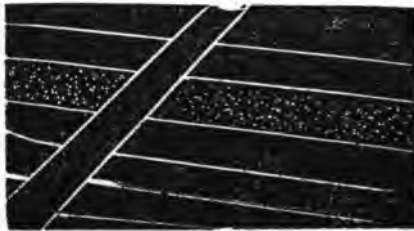
Bark....converted into pure coal

Wood...into a grey sand-stone

Pith into a flinty matter.

A curious inquiry presents itself in the fossil stems of plants ; the bark becomes carbonized and thus an imperishable cylinder of bituminous matter is formed. I think the internal woody fibre is carried away after putrefaction, by filtration, and the cylinder filled up with a deposit of sand stone by the same process.

Branches of trees, roots and stems are sometimes found lying in a contrary direction to the strata, as previously stated in the Up Holland formation (page 22) and as here represented.

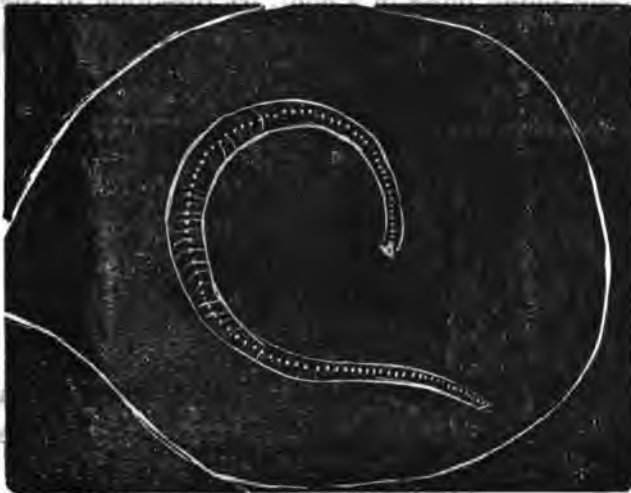


This is accounted for by the rock being of a sedimentary nature, and of later date than the vegetable existence of the fossil.

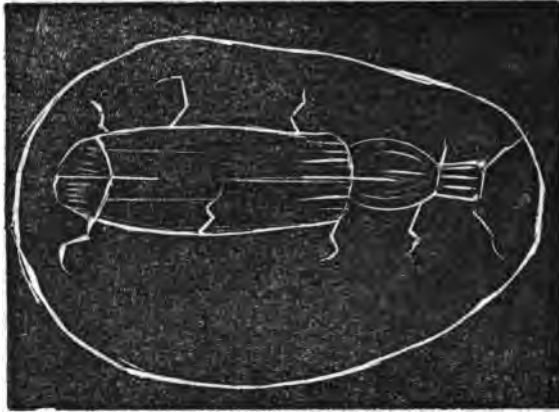
I have not seen any of the animal kingdom in the fossil state in the coal strata, with the exception of masses of shells in the shales.

The fresh water bivalves are very numerous, particularly in the adjoining township of Dukinfield; and are found at various depths.

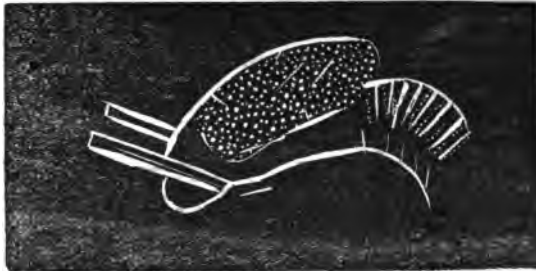
There are, however, some exceptions; I shall here introduce two beautiful specimens which are in nodules of iron-stone and so perfect as to leave no doubt of their animated origin, the following specimen of the snake species



was found in Dukinfield, and the second in Ashton parish, near Fair Bottom, in a nodule of iron-stone.



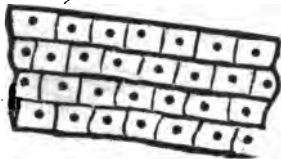
The following is not from the neighbourhood of Ashton, but one presented to me by Elias Hall, of Castleton, and is evidently the remains of a large moth, it was found in the lias, I am not, however, acquainted with its particular locality :



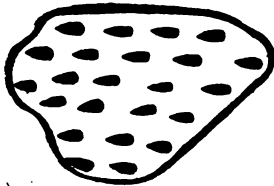
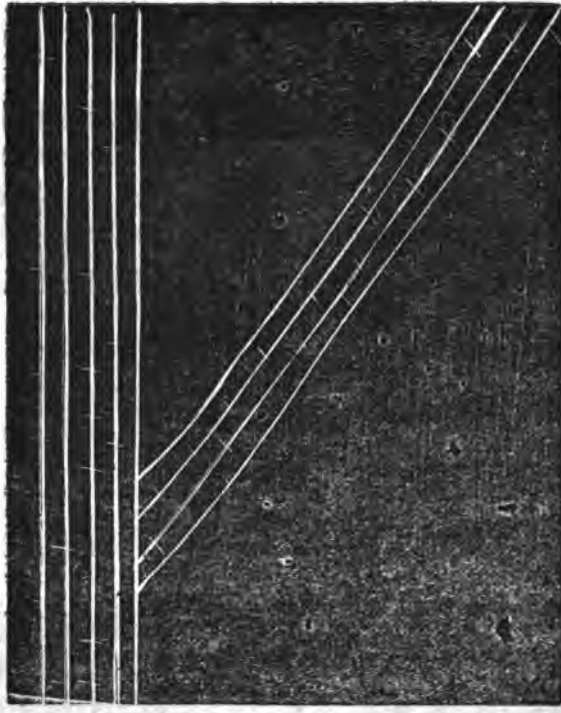
That some mines possess vegetable impressions while others have none, cannot arise from extreme age; as some mines which shew these impressions most beautifully are deeper than others that have none, and may therefore with much greater propriety be attributed to the quickness or slowness of the chemical process, as is the case with crystallization, or to the presence or absence of water, as before stated. In some instances the fossil has been found contrary to the dip of the mine, but generally the strata of vegetable matter takes the same course as the mine.

The vast variety of fossil impressions met with in the coal strata prevents me from giving outlines of the whole. A selection of the most interesting, out of near six hundred specimens, must therefore suffice for illustration.

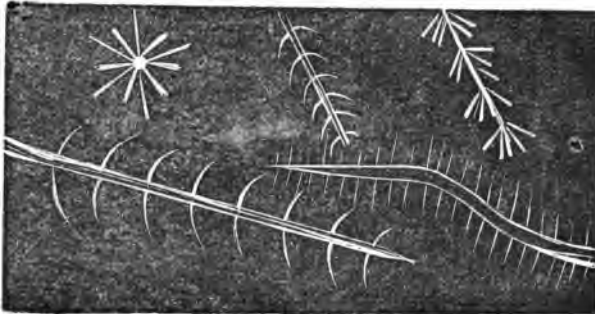
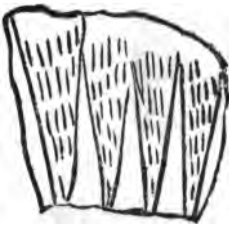
As before stated, the most numerous of vegetable impressions in the coal strata, are the barks, stems, &c., of which the following are a few examples:

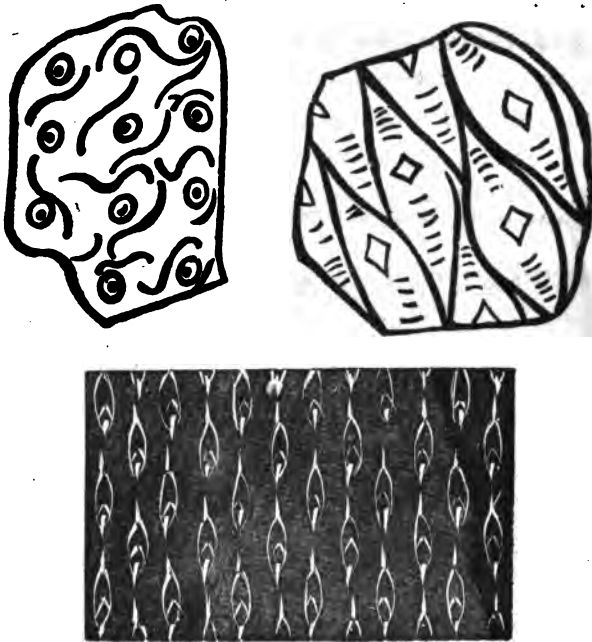


The original of the following is a magnificent specimen, the mass in which the fossil is imbedded being upwards of four feet in length and two in breadth, the upright stem and the oblique one about equal lengths.



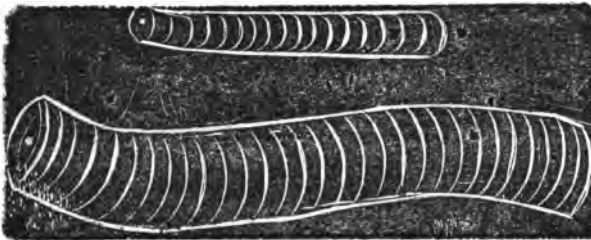
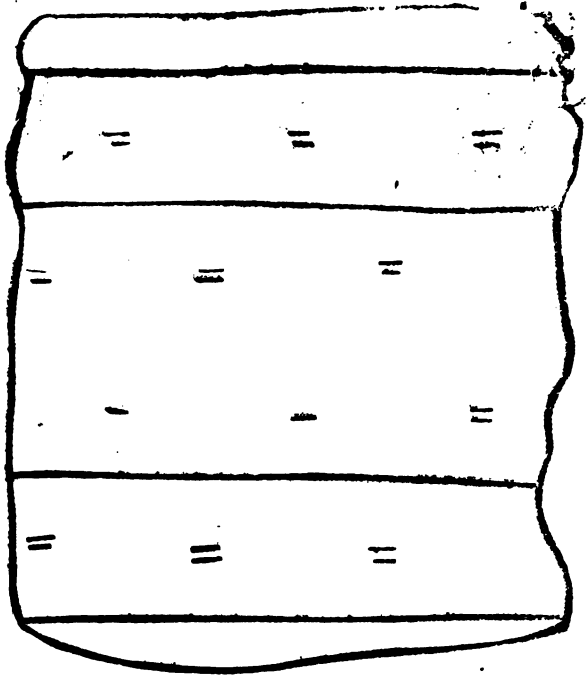
The following specimen is from the Higher Mill stone grit, the fossil is here shown partly imbedded in the rock, the rest detached, the whole forming a reed of five feet and a-half in length; in removing it from the rock it was broken into four pieces. Figure I. is the rock, II. is the fossil reed.

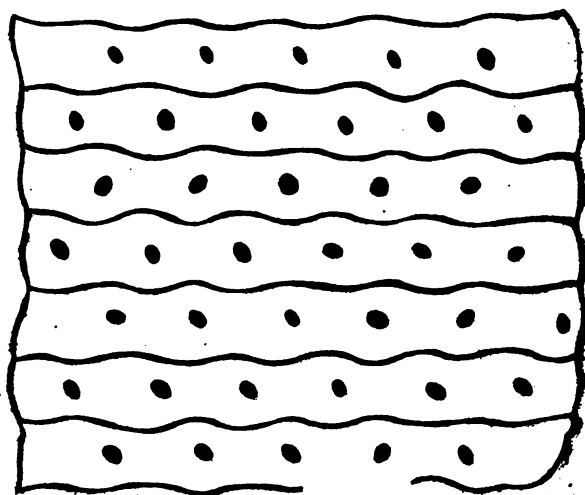
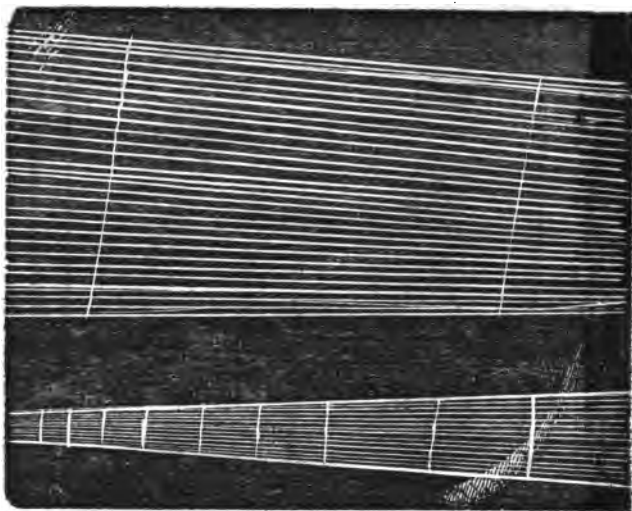


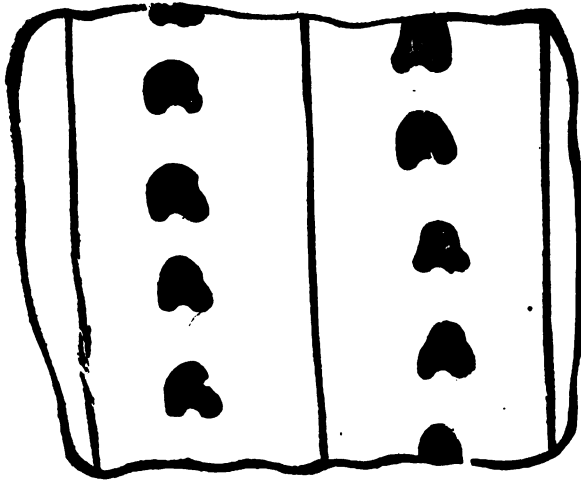


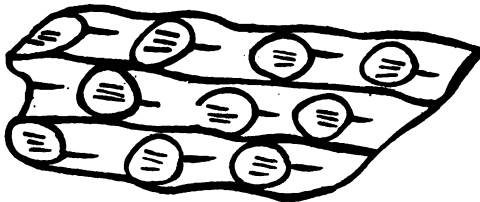
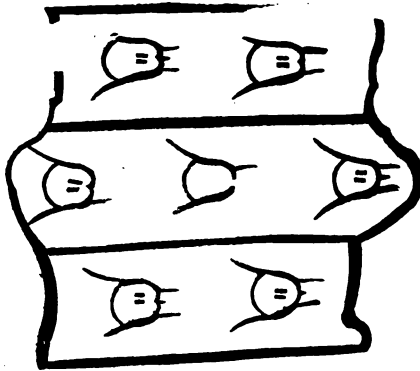
The following outline of a *Sigillaria* forms but a very small portion of the original from which it was taken ; some idea may be formed by stating the measurement. The original is a perfect stem, five feet long and twenty-six inches in circumference, and that this fossil, magnificent as it is, forms but a small part of the original vegetable is known by the fact that though five feet in length the tapering is not more than one quarter of an inch in the circumference. This fossil

extends many feet and is one of the best proofs of the enormous size of vegetables in the antediluvian world, it however is often exceeded in dimensions by the outline of a *Sigillaria* page 48.

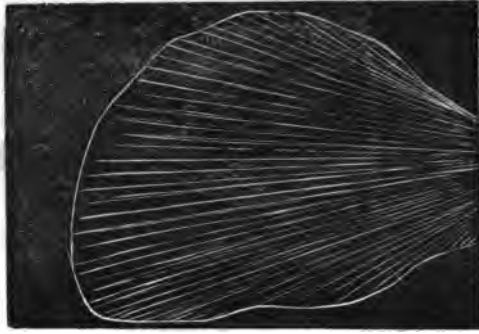




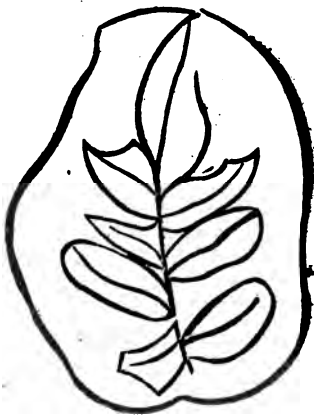


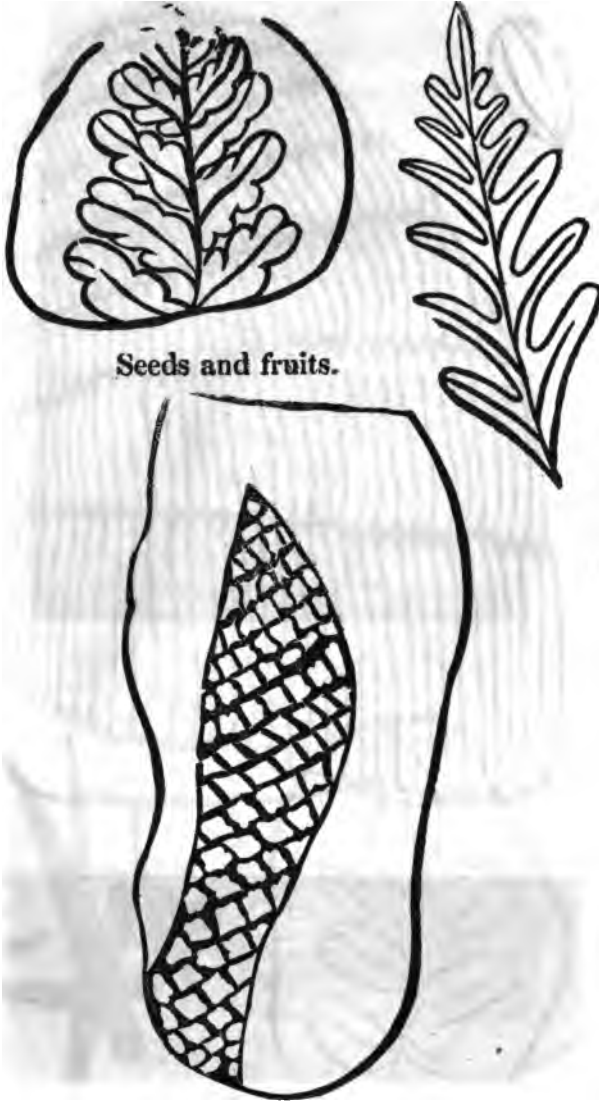


The next in order for being numerous are the leaves, the following are a few examples.

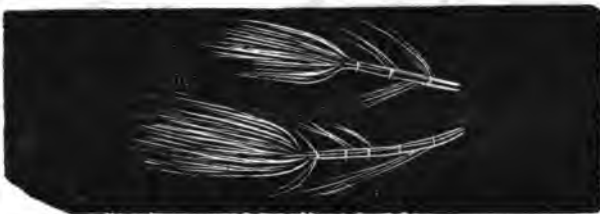
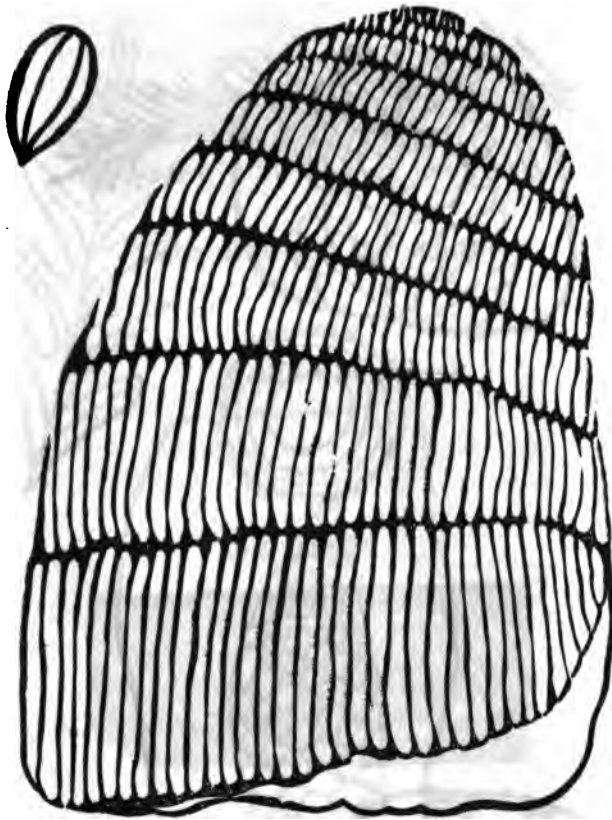


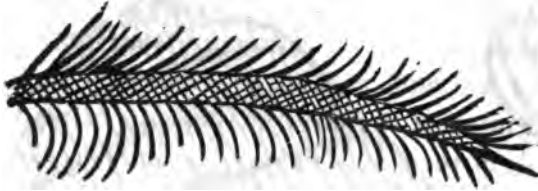






Seeds and fruits.





Supposed flower in coal.



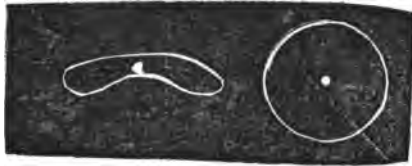
Shells, &c.



Such are the general appearances of these fossil impressions ; and though mere outlines, yet they are sufficient to convince any unprejudiced mind of the absurdity of supposing the originals of these specimens to be mere freaks of nature, as some of the early geological writers would have lead us to suppose. That they are therefore, the remains of vegetables which once flourished on the surface of the earth cannot be questioned. The same species may not perhaps be found at the present day ; but so near is the resemblance, that with such proofs as are now known it would be equally absurd to entertain the least doubt concerning their vegetable origin. The great extent which many of these impressions occupy inclines us to suppose, that the original vegetable production might be of considerable magnitude—much greater indeed than any we now behold ; and therefore many geologists have been induced to state, that at the period when these vegetables existed the whole vegetable kingdom was of a more gigantic description than it assumes at the present day. With regard to this I may state, that the barks and stems are remarkable for their extent in one unbroken line ; but I have not observed any thing remarkable in the size of leaves, fruits, seed-pods, &c., unless the one at page 54 may be considered an exception.

The slow growth of many vegetable classes, the length of time required to fossilize them after their growth is attained, their deep situation in the bowels of the earth, and the quantity and variety of the super-incumbent strata, render it difficult, if not impossible, to attribute the cause of their present situation to the deluge in the time of Noah. Hence it has appeared to many, that a much longer time has been required for completing the process than is allowed for that awful catastrophe. Admitting however that the deluge was the cause of this process, the vast quantity of vegetable fossils found would have the feature of mutilation and bruising, as well as great confusion; if this had really been the case, there would be little or no difficulty in the supposition, that the mighty influx of waters with its consequences with have changed the situation of the vegetable substances from one part of the globe to another where they could not have existed in a living state, as easily as the mountain stream plays with the pebble when throwing it from one bank to another: nor should we then be at all surprised if we found a plant whose origin bloomed in the sultry regions of Africa now imbedded deeply in the crust of the earth in the polar regions; or the remains of a delicate fruit, or still more delicate flower, deep

in the bowels of a land whose climate at the present day is the very opposite to that in which it had existed in a vegetable state. Such however is not the case, we find no particular bruising or mutilation except what arises from great pressure, nor is there any extensive confusion amongst them. The sharpest points, the most delicate fibres are preserved uninjured, sufficiently demonstrating that though imbedded deeply they are still in the same locality as when they were in the pride of their growth. The immense pressure fossil stems have undergone render a variety of appearance from nearly circular to almost flat, and this in proportion to their inclination from the perpendicular to the horizontal, the perpendicular stems being circular and but little altered, while the oblique are oval and the horizontal nearly flat, and the pith of the vegetable almost pressed out of the stem, thus,



proving most decidedly the recent state of the stem when subjected to the pressure.

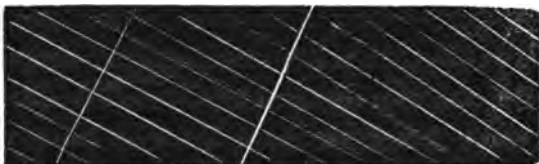
Fossil vegetable remains are remarkable as to

their appearance in the mine or shale; for instance, we find an upright stem in a particular part and when we wish to trace it in both directions we find the stem obliterates itself on coming in contact with a strata of another nature; perhaps the chemical process in the adjoining layers of matter is attended by such results as tend to destroy the vegetable impression. The outline, page 22, will illustrate this point.

The outline, page 55, described as a supposed flower I conceive has no claim to such distinction, since I believe them to arise from very different causes. I have seen but very few of these impressions, and *always on the coal itself* on the surface of the mine next to the shale; and as I stated in the last paragraph that stems obliterate themselves on passing out of the strata where we find them, I cannot but think that these supposed flowers are merely a representation of the section or end of the stem impressed on the coal on which it rests.

At the sinking of a new shaft at Hole Bottom, in this parish, the soft shale presents a singular appearance; the strata of the shale takes upon itself a considerable dip, but it is intersected by numerous fissures running in quite the con-

trary direction, varying from half an inch to three or four inches in thickness, the fissures are in straight lines and filled up with *hard sand stone*; it appears this shale must either have been rent by violence so as to present this appearance or it has contracted after being solid; the sand stone has been carried into these fissures by filtration of the sand stone strata above the shale, through the agency of water.



At this shaft is also shown a hard compact sand stone formation, quite full of vegetable matter and thirty eight yards thick; it has a very similar appearance to the Bardsley rock but harder and fuller of vegetable matter; in other parts of the parish the space occupied by this rock is loose material; the situation of this rock will be found in the section, page 29, under the name of New rock. The vegetable stems found chiefly in it are similar to the lower figure page 46.

Another peculiar feature in the strata on the road side at Roe-cross, two and a-half miles from

the town of Ashton, I shall briefly notice. The shaly strata between the higher and lower mill stone grits are curved at their summits and by this curve form the outline of the surface of the hill side where it appears ; the following is a view of it,



There is no doubt but this appearance has been caused by the action of water.

I shall now refer the reader back to the subject of peat moss, previous to concluding this portion of my sketches and the following remarks as to the origin of peat moss, from Whittaker's History of Manchester, 2nd Vol., Page 112 and 113, are interesting and worthy of notice. "The sand and loam of a wooded hollow sometimes received the waters of an obstructed brook, or drank in the showers of the winter, till the soil became soft and spongy, and trees were unable to support themselves upon it, and sometimes the trees were thrown or cut down,

as many in our Manchester mosses appear to have been actually cut, and originally obstructed the passage of the waters. Thus that particular region of Failsworth moss which was traversed by the Roman road, and was evidently the boggiest part of it, being now reduced nearer the original level of the ground, has a considerable descent to it on either side, and the highest part of Chatmoss about two centuries ago, upon an extraordinary discharge of the waters, appeared to be a valley traversed by a brook. Every drain for the moisture being thus choked up, and the place constantly supplied with a recruit of it, the principles of putrid vegetation would begin to act, and a rank harvest overspread the face of the whole. This dying every year, and being every year succeeded by a fresh crop, a coat would gradually rise upon the surface, and in a century form a considerable crust. This is found upon our mosses two, three, or four yards thick. And, as the great body of stagnated water was fed with supplies from the original current, additional influxes, or both, the morass would extend itself, desert the natural or artificial hollow in which it was originally formed, and creep over the neighbouring lands. Thus the waste of Chat moss began at first in the cavity of a little valley, and afterwards

usurped the loftier grounds about it; a large portion of it now lying higher than many parts of the neighbouring country, and the centre being higher than the rest. And, in these efforts, the imprisoned waters have sometimes so violently distended the coat, that the texture of it has been broken, the country has been deluged with an inky torrent, and the fields overspread with a destructive slime. Thus our own Hough's moss burst on new years' day in 1633, spread a deep bed of filth over the lands, and poisoned all the fish in the rivulets. And upon any long continuance of rain at present, the crust of Chat moss is visibly lifted up by the waters, and even rises so considerably as to intercept some prospects across it. Nor is the firmer ground of our black moors any thing else in reality, than such an extent of mossy soil discharged of its waters. This has been dried by the accidental diversion or omission of the feeding rill, or had all its moisture exhausted by the luxuriant harvest above. On Walkden and Kearsley moors have been found innumerable trees, firs, birches, quickens, and oaks, buried in the foreign soil; and directly under it and even four yards below the surface, a lank grass has been discovered in plenty, lying upon the natural mould."

The Ashton moss though subjected to a powerful draining process exhibits as yet no appearances as mentioned in this note from Whittaker, which leads me still to think the present moss does not rest on its original site, as I have already mentioned at page 15, but has been moved from a higher situation. The draining has not been as yet however to its full extent, and it may hereafter be proved to have arisen from the obstruction of small water courses supplying it in its present situation, but the following remarks from a short history of the town and parish of Ashton-under-lyne, by Butterworth, confirms the views I have here formed; I have examined the locality alluded to by him and find it in substance correct; it runs thus: "The most northerly part of the hamlet of Alt in the parish of Ashton (observe this is in the high lands of the parish, three miles from the present moss land,) consists of a narrow piece of land *extending southward*, which is named Turf pits, on which a person of the name of Saxon (an ancient family in this parish) built a dwelling house, when the builders dug for clay to make bricks they found large masses of trees, which to appearance might have lain there since some great revolution in nature. The earth still retains that black combustible colour peculiar to

peat." These trees were chiefly birch, and on the descent of the land southward are localities still bearing the names of "Farther Birches," "Two Birches," "Nearer Birches," &c., alluding no doubt to large groves of these trees giving names to the places and which in all probability were dragged along with the moss in its descent to its present site. The peculiar situation of vast quantities of birch under the present moss, their leaning position southward, and lastly that birch is a tree claiming mountainous districts for its growth, lead me to conclude that Ashton moss has, at some former period, descended from a higher site. The character of the surface from the high to the low land, which seems at the present time to oppose this supposition, may have been considerably altered since that event took place.

Such then are the facts which I have collected together during my geological rambles in my own parish and neighbourhood. I trust they are not entirely void of interest and that their publicity will encourage others to similar pursuits, and shall conclude this part of my little work with an observation on the probability of peat forming coal beds. I have never yet seen in one instance vegetable stems in a fossil state forming

coal, but in all the barks and leaves do form coal; in proof of this all fossils' stems have their barks and leaves changed to coal but remain themselves as shale or sand stone; in the mines of coal itself we find *no stems*, and this leads me to conclude that in order that it should form a solid strata of pure coal it is necessary for the vegetable matter, *particularly the stems*, to undergo a chemical decomposition previous to its entombment in the deeper strata of the earth's crust: I therefore think the formation of peat is the preparatory process for the after-coal formation; and I may add, what are the shales of the coal mines but the marl of peat bogs (a never failing accompaniment) under great pressure, and which retains with peculiar correctness the outlines of the many vegetables that flourished before and after the formation of peat and subsequently of coal?

In order to give a better idea of the beauty of vegetable fossils I have introduced a lithographed plate, opposite the title page, of a few of these relics of the earlier ages of this world; see Fig. 1, 2, & 3. Figure 4 is a specimen of finely laminated coal, at every splitting presenting to the eye a number of circular spots polished in the highest degree, having the appearance

of mirrors, in the mines it reflects back the light powerfully; specimens equal to the one here represented are scarce, I never met with any but this, though I have seen many somewhat approaching it—but far inferior.

END OF THE FIRST PART.

PART SECOND.

OBSERVATIONS ON THE THEORY
OF THE
EARTH'S ORIGINAL FORMATION;
OR A SYSTEM PROPOSED,
COMBINED OF PRE-EXISTING THEORIES.

"That it was one thing to declare that we had not yet discovered the traces of a beginning, and another to deny that the earth ever had a beginning."

Playfair.

"As we are not called upon by Scripture to admit, so neither are we required to deny the supposition that *the matter without form, and void, out of which this globe of earth was framed, may have consisted of the wrecks and relics of more ancient worlds, created and destroyed by the same Almighty power which called our world into being and will one day cause it to pass away.*"

Bishop of London's Address.

In approaching this very intricate and very difficult subject, I am aware that I am adding to the fanciful and speculative theories which may be said to be already too numerous; and in doing so may lay myself open to much criticism, if not animadversion, and be challenged as the means of retarding rather than advancing

the science of geology. I feel justified, however, in attempting to combine a few ideas concerning the earth's original formation, hoping thereby to add something to the interest already excited, with regard to the promotion of geological inquiry. That the reader may not imagine the substance of the following as an echo of modern opinions, it may be stated that the whole of these remarks were given to the public as early as 1828, and of course could have no connection with what has since appeared only by coincidence of opinion. It has often been remarked, and with considerable propriety, that time spent in theorizing is often mispent; and as regards the science of geology it is perhaps too true, inasmuch as the theories hitherto promulgated are so various, inconsistent, and contradictory, if not really absurd, as to offer considerable embarrassment to the progress of a study so interesting in itself, and so conducive to the interests of science in general. Still it may be reasonably supposed that an individual commencing researches in geology might wish to be made acquainted with the most probable views as to the first formation, our curiosity as to first causes receiving no diminution, but rather increase, by the multitude of facts which are daily developed. These views will always be interest-

ing to the geologist; and, like the philosopher's stone, the consideration of them may promote the object by the many useful discoveries that will be made while engaged in its pursuit. So it is with geological theories. Had it not been for the great ingenuity and research displayed in finding objects to maintain the opinions of various theorists, the progress of the science of geology would have been at this moment very limited indeed. I am therefore of opinion, that it is possible to form a theory from the various speculations of past writers confirmed or supported by modern discoveries, by way of introduction to the science; though I may fail in rendering it an object worthy of general adoption. This may be termed the theory of combination, because it is not formed of strictly independent materials, but is indebted to the views of others, while at the same time it disclaims connection with the doctrines of any particular school, which has often led to the propagation of great absurdities, especially by the ancient writers, who were so warmly attached to some particular party as to overlook the errors they were entailing on the future progress of the science.

In directing your attention more immediately to the subject of the present inquiry, viz., the

original formation of the globe on which we live; it is far from my intention to lead you to the thoughts of universal creation. It will be quite sufficient for our limited faculties to judge with any thing like probability concerning the original formation of that planet with which we are more immediately connected, though it forms but a speck when compared with the vast and illimitable extent of space, and counts but one of those countless millions of worlds, which exist in universal creation.

Still I feel it necessary to indulge in the ideas of universal creation so far as to add my approval to the doctrines as lately developed by Sir Wm. Herschell, showing how intimately the science of geology is connected with that of astronomy. That the planetary bodies in our solar system (our earth being one) were originally in a state of gas and in that gaseous state perhaps separated from the Sun, whose primeval origin was the same. That these floating bodies of gas on removal from their situation of light and heat the process of condensation commenced as in crystalization, by first forming a nucleus, and these bodies forming at very many different points in our system were the foundation of as many worlds or planets, the gaseous matter by

which each nucleus was surrounded rushing to the surface of the forming planet by the laws of attraction to be afterwards consolidated there, producing a rotatory motion round its own axis, while the same law produced the same motion round the sun, at once completing the work of our solar system out of perhaps countless millions. To support this nebular theory Sir Wm. Herschell has discovered planetary worlds in every stage of formation, from a thin nebulous atmosphere to the consolidated and habitable world like our own. Chemical philosophy has already proved that every material of which our planet is composed may, by sufficient heat, be converted into a gaseous body; and, also, that gaseous bodies may be, and are frequently, reduced to a solid state. If the theory of Herschell is at all probable, then the observations I am about to make on the subsequent arrangement of the materials of our planet, by the law of specific gravity, must have greater weight; but that the reader may not draw any wrong conclusions I would earnestly advise him to read Nicholl's *Architecture of the Heavens*, a work so beautifully written, so plain to understand, and so free from technicalities, that the views of Herschell cannot be misunderstood; that ascertained, he will be the more disposed to follow my future observations.

First then as regards the period when the earth was first created. It has been the opinion of some writers that the age of the world is beyond all calculation, others fix it at a very remote period, while others adhere so strictly to the account given in the Scriptures as to state the age of the earth to be very limited,—so limited indeed as to present considerable difficulties in the way of explaining satisfactorily many of the appearances in geology. It is my intention to shew, that the sacred writings are still the best guides we have to a proper and consistent theory : and though they form the foundation of the Mosaic school, still some portions of it have not been understood in a way to complete the theory so as to make it consistent in all its bearings. It is admitted by all writers, that both the old and new testaments abound with figurative expressions, and thereby are answered the wisest and best of purposes. For had it been otherwise, had plain statements of facts been substituted, they might have failed in making the desired impressions on the mind of man. I conclude therefore that we may receive the language of Scripture with regard to the creation, as figurative ; because it is only by so receiving it that we can ever hope to arrive at any thing like a just conclusion on this sub-

ject, and put an end to the various contending opinions which have arisen from regarding the words of Holy Writ merely as they are expressed. The first great axiom, and one in which all theologians and geologists agree, is, that "in the beginning God created the heavens and the earth." This, no one but those whose opinions are not worth the most trifling notice has ever attempted to deny. I conclude, therefore, that in the beginning God did create the whole of what was created in universal space, that to God all things were possible, and that between the non-existence and the existence of matter no sensible portion of time was manifest, the whole being the instantaneous work of that Almighty Being who "spake, and it was done," who "commanded, and it stood fast."

When this beginning was, is a question of great difficulty. Moses might have used the word "beginning," as a sublime indefinite, alluding to a period which was beyond his comprehension. It is evident the beginning might include vast epochs of time during the mineral ages of the world, of which we shall hereafter speak more particularly. The sacred historian informs us that in six days the work of creation was completed, and that God, the all-wise

Creator, rested on the seventh day. If any portions of the Bible tend to confirm figurative writing, they are those which have a reference to the word "day;" and so far particularly fortunate for geological inquiry. That the days of creation are vast epochs of time cannot be denied, nor even doubted, if the sacred volume be examined as a whole. Though the first chapter of Genesis is not prophetic, but written as a record or statement of facts, yet there is every reason to believe that the facts might not have made a due impression if they had not been assisted by a figurative style of expression. A few quotations, in reference to the word "day," will be sufficient for our purpose. Christ said to the Jews, "Abraham rejoiced to see my day, and he saw it, and was glad." This expression refers either to the whole term of our Saviour's life, or to the time of his public ministry. "The day of temptation in the wilderness," evidently refers to the forty years which the Israelites passed in the desert. The prophet Malachi calls the christian dispensation "the day," which has already occupied near two thousand years. The fourth verse of the second chapter of Genesis is still more to the point, as it is not prophetic, and on the very subject itself; "these are the generations of the

heavens and of the earth when they were created, in the day that the Lord God made the earth and the heavens," which day evidently includes the six days spoken of at the creation. And St. Peter declares, that "one day is with the Lord as a thousand years." Can any thing be more satisfactory as to days being vast epochs of time, thus figuratively described in the language of the inspired volume? Another circumstance is worthy of our notice. A day with us is measured by the revolution of the earth on its axis, and we calculate time by the position of the Sun, and which occupies twenty-four hours. Thus it is evident that the first three days of the creation could have no reference to days of twenty-four hours long, as the sun itself was not created until the fourth day. Again, let us suppose that at some future period we endeavour to enlighten the inhabitants of the polar regions by the scriptures, how are we to explain to them our ideas of days of the creative process, their days being many of our months in length? Much has been said and written of late years in reference to this point, but those who wish to enforce the word "day" to be as of twenty-four hours do not appear inclined to grapple with the difficulty of the polar day and night; if the geologist were to calculate the past time on the

principle of the polar day and night he would have much less difficulties to encounter as to the period elapsed. That the scriptures, therefore, cannot be construed literally in reference to the history of the earth, is very evident, as it would lead to the greatest absurdities. For instance, "in six days the Lord created the heavens and the earth, and rested on the seventh day;" but can it be supposed for a moment that God required rest after his labour? It must therefore be assumed, that after six days or epochs of time God ceased to create, and so "rested from all his work." But the argument is often used, that it derogates from the greatness and power of God to suppose that he spent some thousands of years in bringing this globe to its present state, and that it is a lowering of his dignity to have been engaged in a progressive work for such a length of time. Assertions like these are unwarrantable, if not daring and impious. It is not what God could have done that we are inquiring after, but what he has done. We might say in return, that to suppose he occupied six days in the creative process would be derogatory to his greatness; for it is most probable that the creation of matter was instantaneous, that the six days spoken of were occupied by the laws which had been given to matter to develop its mysteries, and that a length of

time was absolutely necessary to preserve the order of things for such developments. Who, therefore, that has ever observed, especially with microscopic power, the wonders of nature, would dare to assert that the time was occupied in a mean or trifling employment? When I think of the immense period required to perfect the plan of creation, I cannot but think that God adopted this plan that he might observe with pleasure the operation of those laws bestowed on the matter which he had previously created. Lastly, it is evident that the expression "in the beginning God created the heavens and the earth," implies an instantaneous creation of matter in the first instance; and the rest depending on the laws given by him to the created mass.

Many writers who once firmly maintained the six days as literal of twenty-four hours in length are now inclined to admit that the words "*in the beginning*" allude to a vast space of time previous to the operations of the six days. This is only a different way of arriving at the same end, and even this admitted will remove many of the geologist's difficulties, and render him less liable to be censured by theological writers.

From what has been stated I conclude that

between the first verse of the first chapter of Genesis and the second step of God towards the creative process, a great space of time might intervene, for purposes which I shall afterwards endeavour to show.

The whole kingdom of nature, with which we are acquainted, is divisible into three great classes—mineral, vegetable, and animal; and it must be apparent to every one that the mineral kingdom was the first in the order of creation, for until there was a resting-place no vegetation could have existed. On this supposition the vegetable kingdom was second in the order of development, and which must have existed a considerable time before the third era of creation which consisted of the animal kingdom, and which could not have existed without a previous vegetable surface.

Again, the animal kingdom had probably two great epochs; the first, animals of a gigantic size and previous to man's appearance; and the second, the creation of man and those subsequent to his time. Previous to the creation of man, the vegetable kingdom was probably as gigantic in proportion as the animals which had

At that time to subsist upon it: for it is a point undeniably proved by the fossil remains which have been discovered, that both the animal and vegetable kingdoms have had their larger species running gradually extinct since the period of their first creation. The temperature of the earth gradually decreasing may be esteemed a cause of the animal and vegetable kingdoms becoming extinct in their larger species. This in a great measure is proved by the largest animals occupying the hottest regions, and the species of plants generally found as fossils are of a nature requiring great heat and moisture to acquire the growth which they appear to have attained previous to their fossilized state.

Having made these few observations concerning the creation, and probable decrease of the earth's temperature, I now come to consider secondly,—though all that we can advance on this point must in a great measure depend on supposition—the most probable system of primary arrangement.

In the beginning God created the world we inhabit, that is, the whole of the matter which composed the world, including every atom which is at present in the animal and vegetable king-

doms ; in other words, the whole of the three kingdoms of nature were first created in the mineral world. If we turn to scripture we are borne out in this statement by the following quotations : “and God said let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit after his kind, *whose seed is in itself, upon the earth* : and it was so ;” again, “let the waters bring forth abundantly *the moving creature that hath life* :” and lastly, “the Lord God formed man *of the dust of the ground*, and breathed into his nostrils the breath of life ; and man became a living soul ;”—all shewing in language too plain to be misunderstood, that the origin of the animal and vegetable kingdoms was derived from the mineral. Thus then the mineral world was first created, and it remains for us to consider what order or arrangement it first most probably assumed. Are we to suppose that there was no arrangement at all, and that confusion reigned supreme ? Or, that God created all things in order and regularity ? which supposition is the most consistent with our knowledge of the divine attributes ? certainly the latter. And is not this view confirmed by all the regulations and processes of nature, in every part of which, from the painting of the wing of the moth to the whirling of the countless

planets round their centres in universal space, the utmost order and regularity prevail? Some fancy the origin of things to have been confusion, from the words in the third verse of the first chapter of Genesis, "and the earth was without form and void." This however is a figurative expression, denoting the great sameness of appearance as to the surface of the earth; it being quite reasonable to suppose that the first formation was only as it were a step towards the after-process, and that the earth had not then assumed the form or character which God intended it to assume in future. The word chaos cannot well be construed into confusion. We might call night a chaos of darkness, yet it is perfectly regular in its arrangement. In fact, when the substance of the earth was created its form was incomplete, that is, it had not the arrangement which the Almighty Creator intended it should afterwards assume; it was a wide waste; it presented a sameness of appearance; it was "void," because destitute of those properties of figure, density, (it being then a gaseous mass,) and the remaining features of matter, which are necessary to its mechanical, chemical, and other operations.

But to return to the consideration of the first

created mass of matter, the *mineral world*, condensed from gaseous matter. Whether it originated from the Sun, or any other planet, or was created out of nothing, is an inquiry concerning which we need offer no further speculative opinions than we have already done, in approving of the suggestions offered by the celebrated Herschell. It is quite sufficient for our inquiry as to its primary arrangement, that *the world was made*; and that the first order or arrangement was perfectly regular I will endeavour to shew, after I have drawn the reader's attention to a few geological facts which will materially assist in the explanations to be hereafter given.

1st, The nearer we approach the centre of the earth from its circumference, by mining, &c., the higher the temperature becomes. In sinking artesian wells the boring when at 1,050 feet in depth, the temperature was at the bottom 82, Fahrenheit; while at the top it stands 59. Every 45 feet in depth produces one degree of heat. At 7,380 feet the temperature is equal to boiling water. At 24 miles in depth, a mere trifle compared with a globe of 8,000 miles in diameter, the heat would melt iron. If a circular diagram be drawn upon paper, *three inches in diameter*, the circular mark of the compass

point would exhibit a thickness equal to 25 miles in depth in the crust of the earth, through which we could not penetrate without arriving at a heat equal to the melting of iron.

2nd, The farther we go from the earth's centre, by taking the highest altitudes or ascending in balloons, the lower the temperature becomes.

3rd, At certain altitudes both animals and vegetables cease to exist.

4th, The nearer we approach the centre of the earth the harder, more compact, and durable we find the materials; also their weight or specific gravity is increased.

5th, From the centre to the circumference we find the materials of lighter and less compact substances, until we arrive at the surface which is covered with a loose and light mould.

6th, The nearer we approach the centre of the earth we find the rocks of an igneous character; and as we near the circumference, the rocks and strata partake of the sedimentary or watery origin; a fact of great importance.

It is highly necessary the reader should impress these few facts strongly on his mind, in order that he may be enabled to ascertain the following views more correctly.

Considering therefore that the formation of the earth was conducted with the utmost order and regularity, (which is far more consistent with our ideas of God than that confusion should have distinguished the creative process) it remains to us for an explanation as to the particular form and arrangement which it most likely assumed when first originated. First then I would maintain, that the centre of this our terrestrial globe is in a state of active combustion; in other words, it is heated to a much higher temperature than we on the surface of the earth can possibly conceive. The facts stated in the foregoing pages are all confirmative of this; in addition to which I am of opinion that the sun which is the centre of our system is not sufficient of itself at its immense distance to preserve the temperature of the earth for the existence of animal and vegetable life without the aid of a central heat. In those planets which revolve near the sun the central nucleus of heated matter is less in proportion to their size and

relative position ; and in the larger planets which are revolving at greater distances where the sun's rays are less powerful on their surfaces, the central heat is considerably increased.

Geologists of late have endeavoured to bring into disrepute the doctrine of central heat, by enlarging on the well-known fact that the figure of the earth being an oblate spheroid by which the polar regions are brought twelve miles nearer the centre of heat, yet these regions are colder than the equatorial regions though twelve miles farther distant from the central heat than the poles. Now this appears a very singular way of arguing, as it supposes a mass of matter in a fluid state whether cold or hot to take upon itself by rotary motion a certain figure, viz., oblate spheroid ; but while they admit its external figure to be thus characterized they have not yet conceived that the internal part of the earth takes the same outline as the outer crust, but suppose it to remain circular ; thus if the outline of the earth be an oblate spheroid and the internal central nucleus of heat circular, it is evident the polar circles would be nearer and consequently hotter than the equatorial regions, as in the following outline,



This I cannot admit, for whatever figure the outer crust might assume the internal mass will be of the same figure; nay, I should rather suppose that as the outer crust has been more rapidly cooled, and therefore checked in forming its figure, than the internal heated fluid by rotatory motion, the internal mass is more likely to extend laterally into a more perfect oblate spheroid than the external, and by this means approach nearer the equator than the poles and thus cause the equator to be hotter than the poles, thus,

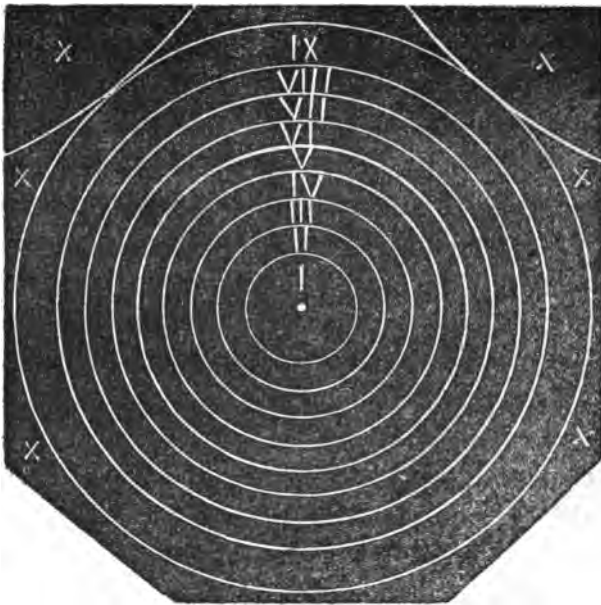


It has also been argued by some able geologists that a heat so intense and in so active a state would endanger the outer crust of the globe. In answer to this I would ask, is it reasonable to form an opinion of the materials which inclose the central heat merely from the knowledge we have attained by penetrating at most 500 yards by mining in the crust of a globe at least 8,000 miles in diameter? Or even with the assistance of nature's dreadful convulsions our acquaintance with the interior of the crust of our earth is not more than five miles. It would be no more absurd to attempt the classi-

fication of vegetables in the moon, of whose climate and peculiarities we are entirely ignorant.

It is quite within the province of reason to suppose that the central heat however intense may be inclosed in materials wisely adapted to resist that heat, though carried a thousand degrees beyond what we with our limited faculties can possibly conceive. The experiments of M. Arago in the Artesian wells at Paris is a convincing proof of this fact. Even at the depth of 1050 feet Fahrenheit's thermometer rose 23 degrees. There is not a miner but will give decided testimony as to the great heat prevailing in mines, whose depths, when compared with the diameter of the globe, are trifling indeed. Admitting then that the central heat is a thousand times greater than is required to melt iron, yet, from one of the facts before stated, as to the materials of which the globe is composed, their density &c., it is easy to conceive that at a certain depth there is a material sufficiently powerful in its combination to resist the heat, however great ; and therefore no probable danger of the earth's crust being melted need be entertained. From what has been advanced concerning the necessity of a central heat we may form some idea of what the mineral world was first com-

posed, and how it was arranged so as to bring about the appearances which it subsequently assumed.



Though the lines in this diagram are circular it is not to be understood that the figure of the earth is circular, that having been satisfactorily proved to be an oblate spheroid. By attentively surveying the figure you will however perceive my idea as to the first command of God, the creation of the mineral world, its materials arranged according

to specific gravity from centre to circumference. I., Is the central heated nucleus. II., Matter sufficiently dense to repel the effects of central heat. III., The granite series. IV., The formations generally called secondary. V., Tertiary formations. VI., Alluvial and diluvial formations. VII., The surface covered with water over the whole. VIII., Atmospheres mixed with clouds, vapours, &c. IX., A thin pure atmosphere. X., The most extremely rarified atmosphere, continuing to a similar atmosphere of another planet. If soil, clay, gravel, sand and water be agitated in a transparent vessel and then allowed to rest we see the same beautiful disposition to arrange, according to their specific gravities, as we observe in the general strata of the earths' crust. Such was most probably the first form of our world, in which it continued for a long series of years, perhaps some thousands, which were only as *a day to God*; and in such a state did it remain until the second step of creation was called forth. Before, however, we proceed to the consideration of the subsequent steps of the creative process, let us take a view of this figure of our globe in its mineral age, and endeavour to ascertain whether the statement will receive any confirmation from the records of Holy Writ.

It appears that the whole surface of solid materials of which the world was composed, was, during the mineral age, covered with water, the next object in the scale of specific gravity to the solid materials; and that the quantity required to cover the whole was much less than would be required at the present time; because the globe at that time had suffered from no convulsion, its surface being perfectly even, no land shewing itself above the waters. Hence the sacred historian observes, "the Spirit of God moved upon the face of the waters." The density of the atmosphere which surrounded our planet at that time, prevented the rays of light from falling upon the more solid materials. This is confirmed by the words, "and darkness was upon the face of the deep." It is particularly worthy of remark that the word "deep" in this last quotation has a reference to the general body of waters only as the land was not then visible. Thus elapsed the first epoch of the mineral world, which might easily be conceived as occupying thousands if not millions of years. The second epoch was ushered in by the introduction of light from the distant luminaries, and the gradual dissipation and purifying of the humid atmospheres; whereby the way was prepared for the grand display of those laws of matter which God in-

tended to manifest when he issued the command, "let the waters under the heaven be gathered together unto one place, and let the dry land appear." That such a command was issued there exists no doubt; the only difficulty is as to the means by which it was effected. We cannot for a moment suppose that if God intended by this command that the waters of the great deep should build themselves up as a wall in one part of the globe, it could not have been done; for he has already shewn an instance of his power in this respect by having divided the waters, and maintaining them so divided for a considerable length of time in the Red Sea for the passage of the Israelites out of the land of Egypt. In the work of the creative process, however, it appears as though the Almighty Creator had so wisely contrived all things, that man might afterwards in some measure explain the operations of nature, and the laws and arrangements by which matter was most likely to be governed. Thus the mighty and universal system was created first instantaneously; and the fixed laws of matter were the cause of those great changes which subsequently took place on the surface of this our globe, as well as on the other worlds floating in universal space. After a certain time had elapsed the command was

issued, "let the dry land appear." This was effected by a mighty convulsion, probably arising from pent up gaseous fluids, which had been generating for some time, and had now arrived at the extreme limit or boundary of compression. From the explosion or liberation of these previously confined gases a convulsion took place which shook the earth to its centre; in consequence of which, very deep fissures or cracks were made into the earths' outer layers of matter. Into these fissures, which are deeper than we have been able to penetrate, the waters rushed with impetuous fury; and by that means came in contact with strata heated to such a high degree of temperature as was sufficient to cause the vast changes which afterwards took place. If a single drop of water be sufficient to burst a brass ball of an inch in diameter, what must have been the effect of many millions of tons rushing into these heated depths towards the centre of the earth? It must have been awful indeed,—surpassing in grandeur and sublimity all those powers of the imagination conferred upon the mind of man. If these fissures only extended to the depth of a few miles all the appearances we see might be accomplished. The equality of the earths' surface would be thereby destroyed. The vast body of waters which entered these chasms,

being converted into elastic vapour, would burst through the superincumbent strata, pushing immense tracts of land before it, heaping land on land above the shell of waters that previously covered the earth; and thus forming vast depths into which the great waters subsided, there resting and forming the bed of the primeval ocean, while the land so forced up became the first tracts of land destined to become the abode of vegetable and animal life. These were the first appearances of that unequal surface which now characterizes our globe,—an inequality absolutely necessary to animal and vegetable existence. But when the convulsions of this earth have ceased, *and that they are gradually ceasing is beyond all denial*, the rains and streams will by degrees level the inequalities of the earth; and when this is accomplished, animal and vegetable life will then exist no longer, the earth will again become a perfectly level surface, a void or waste, and the thin shell of waters will take their place once more in the order of specific gravity beneath the dense atmosphere, and cover the surface of the more solid materials. As it is with mortals so will it be with the world,—it will die, until the fiat of omnipotence shall again command its existence.

If we take a slight view of the lands on the

surface of the globe, does it not confirm this by a chain of mountains running through every portion of land? And where the land is of small extent, is it not generally a mountainous mass? And do not these chains of mountains, which are in reality caused by the rents of the earth, always extend in the same direction as the length of the land raised, thus proving the mountains to be the father-land of the mass attached to them? Mark the appearance of an iron vessel burst with steam; examine its rents; take a profile view of it, and suppose the lower surfaces covered with water. You will then see an exact resemblance to those vast tracts of land, called continents: and thus will the laws of matter tend to explain that obedience to the mighty command, "let the waters be gathered together, and let the dry land appear," which is thus most significantly expressed, "and it was so."

By means of these frequent and most awful convulsions in the primary ages of the terrene mass, the surface assumed that beautiful variety of hill and valley, land and water, which we now observe, and which, as before stated, is so necessary to the existence of an animated creation. When once the rugged tops of the first mountains dared to rear their lofty heads above the

level of the waters, the waters shrunk into the depths they had caused, and the dense atmospheres which had so long shaded our globe from the light of the sun began to condense their aqueous vapours on the summits of the hills, and became the parent of the mountain streams which tossed themselves in all their tortuous windings into the valleys below, there widening into majestic rivers, and rushing headlong to the mighty ocean. The great luminary of day bursting through the now purified atmosphere, the grand scheme of evaporation and condensation commenced with vigour, and has continued to this day. It was not until this period that the vegetation of the earth began. Before, there was no land for vegetation to exist upon. But now the great Creator called into life the vegetable world, "let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after his kind, *whose seed is in itself, upon the earth.*" *Here it is evident that the vegetable germ was previously formed in the first created mineral mass, and that this command only called it into active life. That seeds of plants should be so long imbedded in the earth without germinating, is borne out by every-day facts in places where coal shafts have been sunk ; it being a very common occurrence to find where*

the earthly matter is placed after having been raised up from great depths, new species of vegetables growing upon it, though none of the same nature grow in the immediate neighbourhood. How is this to be accounted for, if we are not to suppose these seeds to have had a previous existence in the bowels of the earth for thousands of years.*

Of the remaining steps of the creative process I shall speak with greater brevity. I have already maintained that the vegetable kingdom existed for a considerable time previous to the creation of the animal kingdom. The wisdom of the Divine Being is evident in such arrangement, viz., in allowing a period to elapse for the gradual perfection of one before the next in succession took place.

* Perhaps it is presuming too much to state that any class of vegetables are *really extinct*, in the face of the surprising facts produced as to the length of time the vitality of seeds has been proved to exist. (See notes in appendix.) Who can tell but the seeds raised up from the deep strata of the earth may, under favourable circumstances, produce those species which our limited faculties have supposed to be extinct? Who can tell but when the surface of this our planet has again become a *wide waste*, again arranged itself in the order of specific gravity, another fiat shall be issued from the great and Almighty God, calling the world again into being and restoring the hosts of vegetables now known with those long supposed extinct, to clothe the earth again *from seeds* now buried deep in the earth's crust, as the scripture saith "whose seed is in itself upon the earth?" Who can tell but the great and wise One ordained that when our planet became too cold for certain vegetable tribes, their seeds should be stored up in the earth's crust for a succeeding world of beings, when the heat and moisture would again be favourable to their growth and existence?

The first stage of creation in the animal kingdom is presumed to have been the monsters of the deep; and next, the large, and in many instances, extinct land animals, followed by the lesser tribes. Then after another lapse of time man was created, who, though he has in one sense been justly styled the lord of creation, was nevertheless the youngest of the world's family. Some writers have supposed that the earth is still in a progressive state of improvement as respects its inhabitants, that man will eventually be displaced by a new and superior order of beings, and that the earth will finally become the abode of angels. Of such opinions I need say nothing; it being sufficient for me to shew that the earth was originally intended to maintain animal and vegetable life, and that both originated in the mineral kingdom of which the earth was originally formed. This brings me to the latter portion of our inquiry, viz., how far will the general features of geology, arising from facts, agree with the opinions here stated?

In making this inquiry we must just glance at some of the most remarkable geological phenomena; and first, of

VOLCANOES AND EARTHQUAKES.

From what has been previously advanced relative to the first convulsions of this terrestrial

globe, you will already have anticipated that I attribute those shocks to earthquakes caused by water coming in contact with the internally heated strata at considerable depths in the crust of the earth. For, wherever expansion has taken place sudden risings of the lands, or mountainous regions, have been the result; and on all occasions a mountainous elevation is accompanied by a corresponding depression in some part of the earth's surface, either under the surface of the ocean, causing a subsiding of its waters, or in some land region swallowing up a portion of the surface, and leaving a visible excavation on it; and though in some instances the connection cannot easily be traced, yet it is no less certain that such is the fact. Thus many of our lakes are the result of such actions in the great chemical laboratory of nature.

Volcanoes are regarded under the same head as earthquakes, inasmuch as their origin is the same. Volcanic eruptions are generally from the summit of mountains, which mountainous elevation was first produced by earthquake; and as volcanoes are generally in the highest class of mountains, it follows, that the connection between the external surface of the earth and the internally heated strata is so far weakened that

the heated portions are pushed by the action of the earthquake to the surface, where they vent their fury in the form of lava. That these terrible actions in nature are considerably decreased since the first ages of the world, and are still declining, is evident from the appearances on the earth's surface at the present time, though that portion which is now land may not be the most ancient of the earth, as regards land-surface. The earthquakes and volcanic actions of modern times are trifling, compared with the vast, awful, and extensive operations of the primeval ages, which appear on almost every quarter of the globe. In the first book of kings, chap. 19, ver. 11, is a beautiful illustration of the great connection of earthquakes with volcanic action. The same connection may be traced in the book of the prophet Amos. That these actions are neither so violent nor extensive as formerly may be considered as owing to the central heat of this our globe having been considerably weakened since the first creation. The wisdom, as well as the power of a divine hand, is manifest in such an arrangement. The object of the first convulsions was to procure inequality of surface; and it therefore required a terrible and most extensively applied power to procure the desired result. But no sooner was this end

accomplished than the remaining efforts were not only weakened, but were not required to the same extent. It may be asked, if our volcanic mountains, those which are still in action, are of older date than the flood, how is it that the flood which covered all did not extinguish them? In answer it may be observed, that if our present land were the bed of the ocean prior to the flood, those volcanic cones might be above the surface of the waters, and consequently their action is kept up. This is the more likely, as the ocean of Noah's day is presumed not to have been so extensive as that which remained after the deluge.

MOUNTAINS,

which are governed by the same means as volcanoes. The most ancient mountains are the highest, while the modern formations are comparatively low. The ancient summits are rugged, the modern are of a smooth outline; evidently shewing that the internal cause of the appearance of the latter is not so powerful at the present day as when the world was in its primeval age. We must also recollect that perhaps the highest and most ancient class of mountains, and which would better illustrate our point, are now most probably buried beneath the ocean's bed, and with whose rugged peaks we are only acquainted by their occasionally peeping above the surface of the waters.

VEGETABLE FOSSILS, AND COAL FORMATIONS.

These have one common origin, and may with propriety be considered as produced by the sinking of a large extent of the earth's surface in the early ages of the world, when it was covered with a gigantic and luxuriant vegetation. Or the formations familiarly called peat bogs may have been sunk by the same means, and by subsequent pressure form a coal field. I feel inclined to think the bog as the first step in the formation of coal, the strong analogies existing between bog and coal bear me out. With peat there is always marl; and what is coal shale but indurated or pressed marl? Iron ore is the companion of peat, so it is with coal. Peat is decayed vegetable matter, and coal is as nearly allied to the vegetable kingdom. I am therefore of opinion that the mass of vegetable matter must be converted into peat by the rotting process before it can form a coal field by any after-process. This view is confirmed by the examination of every vegetable fossil which passes to that state without being formed previously into peat. The stems of trees, plants &c. do not form coal, nor do seeds, but leaves do. Thus we find thousands of stems formed of sand stone while the bark is fine coal. Then why do

we not find stems in the coal fields? Why is it all of one uniform appearance? Because another chemical process took place previous to its assuming its present situation. But where is the improbability in supposing the vast coal-fields with which we are acquainted to have been equally vast forests, previously formed into peat, sunk by the agency of convulsions to their present situation? The thinness of many mines is no contradiction; for the vast superincumbent pressure they have sustained at once relieves us from any difficulty on that head. If the forests of the early ages of the world were as large in proportion as the individual fossils warrant us in supposing, it cannot be too much to presume such forests to have been equal to form the largest coal-bed we are acquainted with. Coal formations may therefore be considered the oldest fossil vegetable matter; and that animals are not found in a fossil state among coal formations arises from the simple fact that the original vegetable matter was sunk previous to the creation of the higher order of the animal kingdom. Some writers suppose it absurd to think that a vegetable world existed long before the animal kingdom: but it is probable, that though a vegetation might exist and no animals to partake of its benefits, yet a wise and omnipotent Creator

might foresee the necessity and value of coal-beds in the future ages of the world.

PRESERVATION OF FOSSILS.

It appears probable that as the various orders of beings advance in the work of creation they become less liable to be preserved in a fossil state. Vegetables being the oldest on record, with the exception of Shells, Zoophytes, &c., are the best. The larger and earlier order of animals follow. This must forcibly strike the mind of every observer. The last in order is man, whose remains have never yet been found satisfactorily in a fossil state. It is true the bones of man have occasionally been found incrustated with earthy matter, but not fossilized. Too much care cannot be taken in enforcing the difference of a fossil from an incrustation; the former is the original substance chemically changed to one of an entirely different character, the latter is merely the original object cased over by other matter. These views are confirmed by daily experience in the fossil kingdom. That human bones are not found fossilized in the deeper stratas arises from the fact of man not existing when these stratas were subject to their great changes. It may also be urged, that the reason we do not find man in any situation in a fossil state is, because the antediluvians,

who of all others were the most likely to be in such a state, would be found in the sub-strata of the antediluvian land, which is now probably buried beneath the surface of the great deep. But let us come to the truth of the matter. Is there not some insurmountable barrier in the composition of the human bone differing from that of the earlier orders of animals, which prevents the process of fossilization? I believe, when abler hands than mine shall have examined the composition of the human frame, and compared it with the chemical composition of bones of other animals in a fossil state which existed prior to his appearance, such perhaps will be the case; and if so, how beautifully does the sacred volume illustrate this point in those never-to-be-forgotten words, "dust thou art, and unto dust shalt thou return,"—as though the divine sentence passed upon man at his first error was for ever to exclude his bones from being memorials to future ages!

The last and principal difficulty I have to contend with in applying these opinions, is the flood of Noah. It has been supposed that this flood covered the whole earth, and it has also been firmly denied. That it did cover the whole of *the then earth* is propable; but in doing so, the

bed on which the ocean rested was left bare ; and the only time when the whole globe was covered with water at one time was in the mineral age, and previous to an inequality of surface. In the just and awful punishment inflicted by the deluge it was not necessary to do more than sufficient for the object in view. It was therefore enough to punish man, that the earth which he inhabited was covered with water ; and by the ocean shifting its bed, and leaving its own situation bare, all was done that was requisite to effect the divine will. It has been said by Dr. Adam Clark, that the Deity never makes an unnecessary display of his power, but accomplishes the greatest purposes by the least possible means. That He acted under this view at the deluge is most probable. It has also been started as a difficulty, that the antediluvian land was greater, as to its surface, than the antediluvian sea ; and therefore the latter would not be sufficient to overwhelm the former. This I am willing to suppose, it being somewhat confirmed by the inspired writings. In order to account for the additional supply, I would observe, that the theory of a comet coming so near the earth's orbit as to give off a great quantity of its waters, is not so absurd as many may suppose. Perhaps this visitant might be in its first state of conden-

sation, from a pure nebulous state thus forming water; and it certainly verifies the language of the sacred volume, "And the flood-gates of heaven were opened." Now this appears still more likely when we consider the present state of our globe, where the waters are to the earth nearly three to one. If the antediluvian sea was so much less than our postdiluvian, where must the additional supply come from, if not from the source just mentioned? It is also very reasonable to suppose that such a sudden influx of waters would be sufficient to throw the earth off its usual balance, and by the shock the sea might be compelled to change the bed it had reposed on for ages. But as our present land was the bed of the ocean at the flood of Noah, a difficulty presents itself as to the fossil remains of animals being found there. The history of the world presents to the limited inquiries of man only one great deluge; but is there any very great improbability in the supposition that other deluges took place long before that of Noah? For, the well-known existence of marine vegetable fossils on land, is confirmative of the land having been once covered by the ocean. But as no other deluge was connected with man's history, the scriptures were not called upon to mention them.

The inquiry, why the fossil tribes of animals and vegetables are larger than existing species, must be answered by the remarkable and well-known fact, that small patches of land only maintain the life of the smallest species of animals and vegetables; some very small islands having scarcely any thing upon them larger than mice, while large tracts of land give succour to the largest tribes both of animals and vegetables; as the elephant, rhinoceros, &c. As therefore the antediluvian land was greater than the present surface, it follows that the race of animals and vegetables was gigantic, when compared with the present tribes; the present surface not being large enough to succour such tribes as the mastodon magatherum, which consequently became extinct. And if by some great epoch in the changes of the earth another such catastrophe as that which occurred in the time of Noah were to take place, and the land subsequent to be less in proportion than at present, our elephants, camelopards, and rhinoceroses, would become liable to the same fate of general extinction. May it not be asked, were not these mighty influxes of waters the great cause of this reduction of temperature of the earth? If the land were of greater surface, the mountains would be of much larger character than at pre-

sent; and, as before stated, such are now lost to our view, unless when they rear their heads above the waves of the sea.

Perhaps it may be proper to state the probability, that sea waters may be one of the great agents of fossilization; and though many of the present fossil tribes are of extinct species, yet if the present bed of the ocean could be examined, might we not find existing species in a state of fossilization? All our monuments of art are modern, compared with those which, in all probability, we should find beneath the surface of the present ocean, which hides the remains of a more ancient inhabited world.

In concluding these observations on the theory of the formation of the earth, I have only to express the sincere and ardent wish that they may be productive of good, unalloyed with the least mixture of evil. The facts upon which that theory is founded, are, as to their existence, undeniable, whatever difference of opinion there may be as to the propriety of their application. Impressed with our own feebleness and very limited powers of investigation, it is indeed with every feeling allied to humility that the human understanding should investigate the works and

contemplate the ways of God, especially those which were displayed "in the beginning," when he "created the heavens and the earth." The immensity and awfulness of the subject; its reference to that wisdom and power which are infinite and almighty, and therefore far beyond the comprehension of man, demand the utmost caution and meekness to be commingled with our admiration and wonder. The more we see of the operations of the Supreme Being, the more we see our weakness; and the more we reflect on the changes which time has already produced, the better are we qualified to form a just estimate of the future.

With these observations I conclude my theoretical enquiries, and the remaining pages will be devoted to sketches that are illustrative of the science of geology without being connected with any particular locality.

APPENDIX.

FORMATION OF COAL.

The following quotation on the formation of coal is taken from Maclaren's geology of Fife and the Lothians, which has issued from the press since the early parts of this work was placed in the printer's hand ; the novelty of the calculation may be of interest to the reader :

“Wood affords about 20 per cent. and coal 80 per cent. of charcoal. Neglecting the oxygen and hydrogen therefore it must have required four tons of wood to yield as much charcoal as we find in one ton of coal. Suppose a forest composed of trees 80 feet high and the trunk of each containing 80 cubic feet and the branches 40, making 120 ; the weight of such a tree will be about 2½ tons ; allowing 130 trees to an acre we then have 300 tons. Supposing the portion that falls annually, leaves and wood, to be equal to one-thirtieth, we have ten tons of wood annually from an acre, which yields two tons of charcoal ; and this charcoal with the addition of bitumen, forms 2½ tons of coal. Now, a cubic yard of coal weighs a ton ; and a bed of coal one

acre in extent, and three feet thick, will contain 4840 tons. It follows, therefore, that one acre of coal is equal to the produce of 1940 acres (that is 4840 divided by 2½) of forest; or if the wood grew all on the spot where its remains exist, the coal bed three feet thick, and one acre in extent, must be the growth of 1940 years! Even if we suppose the vegetation as that of a tropical climate, to be twice as rapid as I have assumed, we shall still require about a thousand years to form a bed of coal one yard thick; and, for the thirty-six yards of coal in the mid Lothian field a period of 36,000 years would be required. When we reflect farther that the coal constitutes only one-thirtieth part of the series of beds comprehended in the group, some of which were probably formed by as slow a process, we shall have no reason to reject Dr. Macculloch's estimate of 600,000 years as too long for the production of the whole mass."

The above theory of coal formation is perhaps more tenable than that of Professor Phillips, who supposes the alternate beds owing to alternate currents from different points of the compass, charged with different sediments, and passing into a great estuary or lake. Lime, he thinks, was transported by the marine currents from the

south-east, because the lime stone beds are thickest in that direction, and thin off towards the opposite point: argillaceous sediment was swept in by currents from the west, the shales being thickest in that direction; while sand and floating wood were drifted from the north, the beds of coal and sand stone being thickest in that direction. Maclaren points out the following difficulty: of the four currents, bearing wood, sand, clay and lime, *how did it happen that three so generally suspended their action while the fourth was operating?*

The descent into the coal strata is generally dirty and disagreeable, miners are often very careless, and to hang in a basket at the end of a rope over a shaft of 300 or 350 yards in depth requires no little nerve; with a steady engineer and good conducting rods these subterraneous excavations may be explored with moderate safety. If the mine be of considerable thickness and moderately dry it is a sight worthy of inspection. The town lane mine, near Ashton-under-lyne, exhibits one of the most beautiful roofs of shale that can be well imagined, the whole being beautifully and regularly printed over by the leaves and small stems of vegetables, and in very considerable variety, so regularly distribu-

ted as to have the appearance of printed cloth, with a small running pattern of black on a slate-coloured ground.

PROCESS OF FOSSILIZATION

Must be either slow or quick ; if very slow, the immense periods of time elapsed, as supposed by geologists, is absolutely necessary for the production of the present appearances ; if quick, such lengths of time would not be required. The proofs of a slow process are abundant, while those of a quick fossilization are very rare. Flowers, when found in a fossil state, would prove the process quick, from the short-lived nature of the flower ; of these, however, I have expressed a doubt in my observations at the commencement of this work, showing that some of the supposed flowers may be the pressure of the end of a perpendicular stem, while others may be seed pods which are often of a very permanent character ; at page 41 however I have produced a very extraordinary proof of quick fossilization in the outline at the foot of the page just mentioned, this is evidently an insect in a state of change from the caterpillar to the moth, the size of the body and the undeveloped character of its small wings, quite inadequate to a body of its size, I think satisfactorily shows

(though only a solitary instance) that the fossilizing process must have been quick to catch this insect in the peculiar character in which we find it. If such proofs were abundant, theologists might argue successfully against the almost indefinite periods of time advanced by the well-authenticated and numerous facts of geological science.

SALT SPRINGS AND MINES.

“The inhabitants of Britain were equally unacquainted with the making of salt. This agreeable and useful seasoning of our food, during the reigns of Augustus and Tiberius, was imported by foreign merchants into the southwestern parts of the island. And, had it been made at all in the kingdom, it would have been within that region of it particularly, and in such quantities as, under the circumstances of the country, would have absolutely prevented any importation. The Romans had long been acquainted with the art, and they brought it very early into Britain. The first attempt would naturally be the easiest, and confined to the margin of the sea, and a very considerable quantity of the finest and firmest salt, in Europe, appears to have been made upon the shores of Britain in the fourth century. But the Romans

had long been instructed to search for the springs of brine in the ground, and to boil the water into cakes, and they actually opened some pits before the middle of the second century. The first were probably the salinæ which were situated in the country of the Cattieuchlani or Cassii, and perhaps at Saludy in Bedfordshire; which are expressly mentioned by Ptolemy, but are now unknown and lost. About the same period or very soon after it, others were sunk at Droitwich in Worcestershire. And subsequently to both, the Romans discovered the salt springs of Cheshire, and opened the necessary wells to them. These were the present pits of Northwich. The spring at Coredate or Kinderton lies seventeen yards below the surface: but at Northwich it rises into eight. The latter therefore would naturally be discovered before the former, though that was at the distance of three or four miles from the Roman station, and this within the area of it; as the mines of solid salt at Northwich lay concealed in the ground and unknown to us all, until the year 1670, and the towns of Saludy perhaps, and certainly of Northwich and Droitwich, arose successively in consequence of these brine pits, and were constructed in the immediate vicinity of them."—Whittaker's *History of Manchester*, volume 2, page 164.

Although the rock salt was known in 1670 the most valuable beds were not discovered until late in the eighteenth century. A Polish gentleman on visiting the mines of Northwich suggested the probability of better salt being beneath the bed which at that time they were working; speculators were not wanting, and soon after the present valuable and almost inexhaustible stratum of salt came into working, producing salt of a much better quality than before obtained. This encouragement led to still deeper penetration into the earth's bowels, but though salt was still found, its quality was not by any means proportionate to the expense; in fact, the present principal mines at Northwich appear to be in quality superior to any other.

The mines at Northwich, in Cheshire, are splendid specimens of the indefatigable industry and ingenuity of man, and are well worthy of a visit from every geologist; their groined roofs supported by immense pillars of salt rock, the snowy carpet of ground salt on the floor of the mine, the enormous extent of the excavations (in one mine sixteen Cheshire acres) and this in a strata of twenty-seven yards in thickness, form an object of wonder and admiration to every visitor.

VITALITY AND IMPERISHABLE NATURE OF VEGETABLE SEEDS.

I have alluded to a fresh race of plants springing up from the soil raised from great depths out of the shaft of coal mines, and differing from the vegetables in the neighbourhood, (see page 98-9,) and the supposition that these seeds must have lain dormant for thousands of years but still preserving their vitality. There are many other proofs of this singular fact; seeds have been found in mummy cases and have vegetated after a repose of 2 or 3,000 years. In the artesian wells the earth brought up by the boring from a depth of 360 feet produced, under a hand glass, healthy vegetables. Seeds of strawberries, apples, &c., have vegetated after they have been taken out of the pots where they were preserved, consequently they have been boiled a long time. Oats, taken from the grave of an aboriginal Briton, sprung up when sown. At Matlock an Elder tree was cut down and placed under a stack, where it was by accident nearly consumed with the stack by fire, in this charcoal state it was driven down to serve as a temporary gate-post, *it vegetated and became a thriving tree.* Nor is the preservation of vitality in animals less remarkable.

VITALITY IN ANIMALS PRESERVED.

The long-doubted and ridiculed statement of the toad found in the rock is now so well authenticated that there can be no hesitation in embracing it as a decided fact. I, for a long time treated it as Buckland and Murchison did—*with contempt*; but now am free to confess myself wrong. Buckland failed in his experiment to prove it, but it is presumed had the animal been in a torpid state before subjected to the experiment it would have succeeded. Dr. Richardson mentioned a fish enclosed in ice found in the polar regions, *how long it had been there was impossible to tell*, yet when released exhibited signs of vitality. *Then why not the toad?* An instance occurred in the parish of Ashton, since this work went to press, of a toad found between the shale and sand stone (enclosed in a small cavity) at the depth of 95 yards; this has been seen and attested by many individuals. Another is now in the museum of the Philosophical Society of Birmingham, which was found at Coventry Park. A friend of mine, on whose veracity I can rely, stated to me an experiment conducted by his father, who also was a *doubter*, the toad was enclosed under a small flower-pot and buried a considerable depth in the earth, after two years it was found *still living*. The marmot,

tortoise, and dormouse have their long stages of torpidity without destroying vitality. Adders have been found in winter hard and brittle with frost, yet after carefully thawing *they live*. Bees after being frozen stiff have returned to life and their hive work by a careful application of heat. Eggs hermetically sealed have been good after 300 years. The milt of the carp has been found alive after the carp was boiled; and lastly, the experiments of Mr. Crosse has *stimulated into vitality the ova of insects found in flint* under the most extraordinary circumstances. Mr. Crosse however, in his enthusiasm, has brought himself under the censure of the world in general, by using too strong language in his descriptions; it surely was enough *to stimulate into existence*, without leading the public mind to suppose *he had created* a new set of living beings that never before existed.

FOSSILS OF ANCIENT HISTORIANS.

Some of the early historical writers noticed fossil remains, but strangely misrepresented them. Holinshed in his chronicles 1577 remarks at page 4 "St. Augustine noteth how he saw a *tooth of a man* that would have made a hundred of his own;" also, John Bocase set down that in a cave of a mountain not far from

Depranum (Sicilia) the body of an exceeding high tyrant was found, whose teeth did weigh 100 ounces each :” and “ In the reign of Tiberius a corpse was found, the teeth of which was so long that on calculation of thirty-two teeth the mouth must have been sixteen feet wide, and could separate the lips to the distance of ten feet,” These remarks of Holinshed are produced to favour the idea of the earlier races of mankind being huge giants. That we have degenerated in latter days is perhaps true, but the remains here alluded to by Holinshed are evidently the relics of much larger animals than the human species, and have so often been verified by modern geological discoveries.

MISINTERPRETATION OF SCRIPTURE ON THE SUPPOSED END OF THE WORLD.

Sismondi, in his fall of the Roman Empire, alludes in the most powerful manner to the general consternation that pervaded the western portion of the world as the completion of the tenth century after the birth of Christ approached, in consequence of the announcement from the Apocalypse “ That after a thousand years Satan would be let loose to deceive the nations ; but that after a little season, God would cause

a fire to come down from heaven and devour him." As the awful time approached society became in a complete state of disorganization, and it was truly wonderful that man escaped the dreadful visitation of famine from the great neglect of every thing at this time. The crisis however approached, arrived and passed by without these dreadful consequences that had been anticipated, and it was generally acknowledged that the scriptures had been misinterpreted. Thus we perceive the awkward situation we are often placed in by enforcing the literal announcements of the inspired writings instead of allowing them to be figuratively or allegorically expressed.

FINAL CONFLAGRATION OF WORLDS.

Can this subject be touched upon by geological writers? Surely it may with an equal degree of propriety as the original formation of worlds. There appears to be two great actions constantly going on in the universal system of nature, both of which have a direct tendency to dissipate matter previously cohered together; the one by intensity of heat directly applied to matter, as in the sun, which without any centrifugal motion of its own, and as the centre of attraction to our system, is constantly separating vast bodies of

gaseous matter from its surface and distributing it into the regions of space amidst the atmospheres of countless millions of planetary worlds: The other is in the planets themselves, each of which possesses a centrifugal motion of its own, and is constantly receiving an additional supply of matter on their outer surface from the sources already mentioned; and the probability is that their circumference is gradually but to us imperceptibly increasing, and if this be the case the rapidity of motion on the outer surface is also increasing. To this rapid motion however there will be a limit beyond which it cannot pass; when time shall have caused the planet to pass through its innumerable changes of renovation and decay, when the rains and streams shall have levelled the highest mountains and filled the deepest vallies, when the temperature of that sphere shall no longer be able to maintain animal and vegetable existence, when the pent-up central fires, with their gaseous products, after long intervals of rest shall again arrive at their utmost limit of compression; when these changes shall have occurred again and again until the sphere is so much enlarged on its outer surface by additional matter that its rapidity can no longer be restrained by cohesive attraction, then will the planet

burst from its centre into countless millions of fragments and dissipate itself into the atmospheres of other worlds,* some portions of which perhaps falling on the nearer planets in the character of meteoric masses, others travelling onwards in the immensity of space, their rapidity and heat progressively increasing during its course until it becomes of that intensity as to change it from a solid to a gaseous body and falls imperceptibly on the next planet that presents its attraction to it, and by this operation increasing its magnitude. Thus worlds are constantly separating from the sun in a gaseous state by heat, to be afterward condensed and run through their destined course of operations, while old worlds are continually breaking up and again terminating in the same gaseous state as when first formed. The variety of strata presented to our view at various depths, exhibiting a succession of surfaces that at very remote periods teemed with organized living beings, and which geologists find such great difficulties in accounting for, may fall within the plan of this scheme without outraging probability. Intense heat began, and intense heat will end the scheme of

* It is a well-known occurrence in the establishments of machine makers, that the grinding stones frequently split from the shafts holding them, by the rapidity of their motion; and this is applicable to stones of large dimensions only, for small ones on the same shaft will at the same time be uninjured.

worlds and the final conflagration spoken of in scripture is thus pointed out.

LIMESTONE CAVERNS AND SCENERY.

Having had occasion in the annexed pages frequently to allude to the name and works of Mr. E. Hall, of Derbyshire, I felt a desire to apprise that venerable and excellently practical geologist of my intentions, and before doing so, if possible, to obtain his sanction to such a liberty. It was with this intention I paid a visit to this worthy man in his truly romantic retreat at Castleton, accompanied by a friend who like myself was an ardent admirer of the wonderful scenery about to be presented to us in the mountainous district of Derbyshire; a few particulars of our visit, connected as it was with some of the principal objects worthy of inspection, may not perhaps be uninteresting to the general reader, and may also serve as a brief yet faithful guide for future visitants in search of the same objects:—Our route lay through Chapel-en-le-frith on a short November day, and darkness set in ere we arrived at the termination of our drive, and it was with no little difficulty we threaded our way during the few last miles of our journey, in consequence of which we had not the opportunity of observing the towering Mam

Tor, the Winnats, and other objects of interest in our approach to Castleton; these pleasures were reserved for the day following and perhaps enjoyed with greater zest after rest and refreshment. On our arrival at one of the principal Inns almost the first object that presented itself was the one for which our journey was taken, viz., Mr. Hall, in company with an agent of government in the ordnance department, who had come from a considerable distance to glean information from the Derbyshire geologist. Making ourselves and our object known it is almost needless to state we met with a hearty reception from the old man, and full permission to quote from his published works whatever we thought of use to us. A pleasant evening followed, chiefly occupied in a little sparring on geological theories. Having made our arrangements for the following day, in which Mr. Hall assisted and promised to take a part, we retired for the night, highly gratified with our company and wondering no little to find such a man in such a place, so far removed from society and yet so generally known to the world at large as a geologist, and of whose practical knowledge other geologists have so often availed themselves.

At nine o'clock the following morning, after

discussing a hearty breakfast, (an indispensable requisite previous to cavern touring,) our guide, a respectable publican in Castleton, (Mr. Roys who rents the Spar Cavern,) waited on us by appointment to conduct us to the Spar Cavern, an object of the highest interest, but which the visitor is sometimes in danger of missing from the foolish contentions and wilful misrepresentations of the exhibitors of the older wonders of the neighbourhood. This Cavern is of modern discovery and only very lately thrown open for public exhibition, and in consequence of being under a different landed proprietor to the rest has caused no little jealousy; these little broils are exceedingly annoying to the visitor, and disgraceful to the inhabitants, and cannot but operate against their best interests, by the visitor often being disgusted before he has traced all the objects worthy of notice. By the advice of Mr. Hall we proceeded with our guide to visit the Spar Cave; our way lay through the Winnats, and on leaving the town in that direction our feelings were wound to the highest pitch of admiration at the noble scene around us which was considerably enhanced by our not being able to observe their beauties on our approach to Castleton the night before.

WINNATS.

The entrance into the Winnats is very imposing, huge masses of limestone towering high above our heads, on each side forming a beautiful avenue clothed with a short green grass, forming a striking contrast to the dark and frowning masses that seemed ready at any moment to hurl destruction on all beneath ; not a tree, not a shrub to be seen, not a sound but the echo of our own footsteps disturbed the quiet of the scene. The short green verdure at our feet, the blue sky above, and rocky masses at our sides were all that met the eye, even the chirp of our familiar friend the sparrow was missing. On turning round we beheld in the distant landscape the little town of Castleton, the square turretted tower of whose little church formed a pleasing object, which was increased in interest by the lofty remains of the once powerful Castle of the Peak, hanging over the town in solemn grandeur, indicating to posterity the mighty influence of the once powerful *Peverils, kings of the peak* ; on our left a beautiful and fertile vale was just opening its beauties to the morning sun.

ECHO.

The position in which we now stood and the

appearances that presented themselves led my friend and myself to imagine it a likely spot for an echo, but on inquiring of our guide he had not heard of any thing of the kind ; not feeling quite satisfied we were determined to try, and charging a pistol which we had procured for another purpose, I took my stand at the mouth of the winnats, nearly opposite an old shaft driven for lead ore, and presenting the pistol in the direction of Castleton church, fired the piece, and to our astonishment no less than six distinct reports followed with a number of smaller ones ; elated by our first trial we repeated the experiment, and could count seven or eight reports ; other parts of the winnats were tried but in no place so effective as this, and the guide promised to direct the attention of future visitors to this pleasing object. We now proceeded on our ramble and crossing over the higher land to our right, at the upper end of the winnat rocks, we came to the entrance of the

SPAR CAVERN.

Preparations having previously been made we lost no time in descending with our torches, &c., and an additional guide down a long flight of steps, at the foot of which the natural fissure or rent in the mountain lime stone presented itself.

This we traced for some time without observing much to excite our curiosity, but as yet our eyes had not sufficiently accommodated themselves to the situation we were in ; gradually, however, the beauties around began to show themselves. The path was circuitous and of easy descent, occasionally the narrow passage widened in a large and beautiful cavern, clothed with stalactites, reflecting back the lights of our torches in the most brilliant manner, while here and there a rich vein of the fluor spar crossed our path, adding new beauties to the scene. We continued our route admiring and wondering at every step, until we arrived at the chief cave, called (from a late visit of the then Earl of Mulgrave) Mulgrave's dining room, from his having refreshed himself there. Our guide now hurried us onward to the termination of our route, while the sub-guide stayed behind to prepare new and unexpected scenes of beauty for us on our return. Hitherto a deadly stillness reigned, broken only by the echo of our own footsteps or our voices, which reverberated from side to side as though we had disturbed the slumbers of some mighty spirits of the cave. After leaving Mulgrave's dining room the roaring and splashing of water was distinctly heard ; our route was more difficult ; at last arrived at the utmost

limit at present ascertained, we could see a little onward narrowing into a small fissure preventing further progress, but from the roaring and hollow sound of the rushing waters there is no doubt of caves still further on, which some hardy miner will ere long discover. Renewing our lights we retraced our steps, and being now quite familiar with the darkness, our eyes were enabled to detect thousands of beauties that we had passed unheeded before, the plain torch light having been our only assistant ; but if our ideas of beauty and splendour had been fully realized hitherto, they fell far short of the scenes that we were now to observe : coloured chemical lights and chandeliers raised by cords to immense heights in the large caves, presented a succession of scenes that at once bids defiance to the ablest pen or pencil, nay, beyond, far beyond the utmost conception of human imagination. The scenes of the Arabian tales were a cypher. Groves of diamonds—Palaces of gold sunk into insignificance amid the gorgeous splendour now surrounding us ; we could have gazed with a never-tiring eye had not our torches signified that though pleasing beyond conception we must now leave it ; reluctantly we gradually retraced our steps towards the mouth of the cave, the guides exerting themselves to exhibit new beau-

ties as we passed along ; at length we arrived at the entrance, and the broad day light once more saluted us ; but so absorbed were we with the scenes just witnessed that all around appeared uninteresting, and it was some time before we could fully appreciate the bold mountainous landscape before us. On awakening from our reflection our attention was arrested by a well-defined and moderately extensive

LANDSLIP

That now lay at the foot of the rocks on which we stood, and in front of the Odin mine ; the mighty mass had been rent from its parent bed and now lay prostrate in the valley below, occupying a space of four or five acres. We could not but observe how much man is indebted to the unsearchable ways of providence. This landslip had been the means of exposing the parent mass so far as to render certain the efforts for getting the lead ore, which has since been worked with so much advantage. We had here, also, a distant view of Mam Tor, one of the named wonders of Derbyshire ; but as the morning had put on a hazy appearance our view was not propitious.

MAM TOR

Is however, as a mountain, nothing remarkable. In its present situation it is a bold and somewhat

pretty object, composed of a loose shaly substance which trickles down its sides on being disturbed by the foot of some tourist; hence it has been called the shivering mountain. On descending the cliffs, into the new road to Castleton, we came in front of the entrance of the

ODIN MINE.

The entrance is very picturesque, and is an object worth the attention of the artist. We did not penetrate its mysteries within, understanding that as a lead mine we should be better pleased by exploring the Speedwell mine at a short distance. We therefore proceeded thither; and now parted with Mr. Roys, our intelligent guide, and under the direction of two new ones we entered the

SPEEDWELL MINE.

A long flight of steps brought us to a boat floating on about three feet of water; a large quantity of candles were now lighted, and as we proceeded along an immense tunnel driven in the solid rock, by the efforts of our principal guide, the other was employed in fixing candles as we passed along, with small pieces of clay, to the sides of the tunnel. As this horizontal shaft was driven in a straight line for 800 yards, the perspective exhibited by the candles was

delightful. When about two-thirds of our sail were accomplished, a stamp with the foot on the bottom of the boat was answered by a peal of thunder. We now missed our pistol, but my friend did not regret it, as the reverberation by the foot was so appalling that had it been a pistol he should have dreaded the effects upon the organ of hearing. The roaring and splashing of a distant waterfall now assailed our ears, and it required no little nerve to divest ourselves of the idea that we were floating to the brink of a fearful precipice, ready to hurl us into some boiling gulph below. In a few minutes our boat touched its landing-place, and our dreadful anticipations ended in our being safe once more on *terra firma*, with a monstrous excavation above our heads and a roaring cataract at our feet, with 70 feet of a fall into a dark and (as the natives call it) an unfathomable abyss. We were now 600 feet below the green grass sod above our heads, and so huge is this cavern that there is little doubt but that it approaches very near the surface. In vain sky rockets have been sent up, the roof has hitherto been hid from human gaze ; we sent up a larger rocket, but unfortunately it burst at about half its altitude, when in throwing out its coloured stars it presented a scene of magnificent grandeur. Various chemical

lights were now used, each adding new beauties : in vain however we looked for the stalactital drapery of the Spar cavern ; the awful grandeur of the Speedwell cavern forms a striking contrast with the gorgeous splendour of the Spar cave. Having satisfied our curiosity with the scenes above, we now turned to the black, boiling, hissing gulph below, which was increased to an awful extent by an additional supply of water by raising a shuttle ; the roaring was truly dreadful. The foot of this waterfall terminates in a pool of water, emptying itself with a gradual descent by a stream, which issues out at the mouth of the Devil's cave close to the town of Castleton, about a mile distant : seating ourselves again in the boat we slowly sailed to the outlet of the cave ; and highly gratified issued from its entrance. As a work of art, showing the enterprise and ingenuity of man, this tunnel is well deserving of the tourist's attention, a visit to this object is well repaid ; but, perhaps, it should be taken first in consideration as it is somewhat depreciated by inspecting the other caves previously. Again changing our guides we proceeded to the great cave of the peak, or, in plainer terms,

THE DEVIL'S CAVE.

The entrance into this stupendous cave lies

in a fissure of limestone, immediately under the keep of peak castle, the mouth of the cave consists of a natural arch of 42 feet high and 120 feet in width ; there is a wildness almost inconceivable about in ; we felt a little disappointed that its natural beauty should be destroyed by allowing a manufactory of ropes to occupy the entrance ; the visitor's reflections are disturbed by varied noises of thirty or forty work people ; advancing forward, the great arch gradually diminishes until we were obliged to stoop ; soon after, the space enlarged again and we found ourselves in the bell house, named so from its shape ; proceeding onward we reached the first water, where the rocks hung so low that we were obliged to lie flat on our backs in a boat, or rather flat tub, while our guides pushed us under the rock which was fourteen yards long ; a few seconds placed us on the floor of an immense cavern whose dimensions we could not as yet fully ascertain, our eyes not having been sufficiently long in these dark regions, as it is always the intention of the guides to hurry to the farthest point as early as possible that more time may be allowed to exhibit the wonders on our return to greater advantage, when the eyes are become familiarized with the place ; we thus proceeded from cavern to cavern, crossing the water several times until

we arrived at the utmost limit, where we rested for a short time, and here one of the guides left us to prepare certain objects for our observation. The stream of water running through these caves is the same with the Speedwell mine, which is easily shown by light bodies (such as saw-dust, feathers, &c.,) being thrown down the Speedwell mine soon show themselves at the Devil's cave: during the working of the Speedwell mines large quantities of rubbish were thrown down, the same is now found in the stream of the Devil's cave, formed into beautiful pebbles by the operation of attrition, and affords an excellent example of the formation of gravel even in a length short of a mile. We now returned and could much better observe the extent as we passed along than as we entered; on turning round the sharp corner of a projecting rock in our path a curious scene presented itself, our extra guide appeared at a distant point surrounded with candles, showing most distinctly three beautiful natural arches in perspective, as well formed as though the chisel had done the work assisted by the hand of man; after gazing a short time the candles went out, the guide disappeared, and we progressed on our way, and now we had reached a spacious cave our guide was again seen at an immense height amid lofty domes, with a

number of candles arranged in a fantastic manner about him ; again he disappeared, and our principal guide gave us some blue lights which threw a wildness and a brilliancy on the scene impossible to describe ; we now proceeded, merely taking a hasty glance at the smaller caves named the Devil's cellar, Tom of Lincoln, &c., to the great cave or Devil's hall ; of this it is utterly impossible to convey anything like a just idea, our guide was placed far as the eye could reach with his candles arranged like the front of an organ, from whence he chaunted with a sweet voice a very pretty simple air of a "*Derbyshire lass with her milking pail* ;" the sound of his voice had a surprising effect, the echoes pealing along the vaulted roofs told powerfully on the ear, we listened and gazed for a considerable time, the blue lights showing the awful extent of this spacious cavern, the dimensions have been taken and are said to be 220 feet long, 200 feet broad, and 120 feet high ; a moderate sized orchestra would in such a place be equal to the whole strength of a musical performance at York Minster, and we could not help thinking what a novelty the Derbyshire people had in their power to give to the public by holding a festival in it. Having arrived at the edge of the water, we got into the boat and soon land-

ed ; our lights were now all blown out and for a short time we stood in utter darkness, the guide then led us past the point of a rock when one of the most beautiful scenes presented itself that the eye ever witnessed ; it was the streamers of daylight pouring their flood of light at the entrance of the cave ; those who have not seen cannot conceive the brilliancy of the scene ; soon after we found ourselves in the open air and the busy din of the rope-makers dissipated the romantic ideas that were so lately prominent. The Devil's cave stands unrivalled for awful grandeur and sublimity, but here, as in the Speedwell mine, nothing but bare rugged limestone met the eye, the stalactite and stalagmite were not to be seen shedding their beauties as in the Spar cave, although a small publication sold by a man named Needham, opposite the principal Inn (and who pestered us no little) would have led us to believe that the great cave abounded in stalactite ; but the only one we saw was a huge one at the entrance over the rope-makers, called the Flitch of Bacon, and which was so smoked and dirty that all its beauties, if ever it had any, were lost ; in fact this cave is too dry in the roof generally for stalactital formation. The present exhibitor is a moderately civil young man but with scarce an idea beyond his hat ; we under-

stood that the venerable geologist, Mr. Hall, had this office from the Duke, but from the working of some peculiar influence he was deprived of it, perhaps that influence extended little further than the butler's pantry or back stairs, for to give the Duke some credit we cannot think his Grace would knowingly have ejected an old and well-informed man from the place, to place the present one there. The pleasure to intelligent visitors would have been increased by the attentions of Mr. Hall, and it would only have been a small trifle for the declining years of a man who has long been a worker for public good. The next object of our notice, and to which we now directed our steps, was

CAVE DALE.

The place so called lies behind the town, immediately under the shattered walls of the Castle, and is one of the prettiest patches of scenery that was ever seen. From the centre of the town to the silence and beauty of this place was only the walk of a very few minutes, and so isolated from human habitations that when in it the stranger might conceive himself a thousand miles from the busy haunts of men. Cave Dale is the Wismats in miniature, piles of massy limestone on each side—the stillness was remarkable—the dark and ivy'd turrets of the Castle peered high

above our heads ; the only contrast was the blue sky above and the green carpet at our feet. We leisurely wound our way amidst these huge piles towards the top of Cave Dale, Mr. Hall kindly pointing out every thing worthy of notice : amongst other matters he announced to us that he would shortly show us some columnar basalt, an assertion we could not have credited had it come from a common guide ; but denial was unnecessary, a few yards further a fine specimen of columnar basalt stood before us ; how it came there was a query of no easy solution ; the matter was discussed for a considerable time with Mr. Hall, who appeared to be of opinion that it had issued from a volcanic crater in the vicinity, and had assumed its crystalline form upon its present limestone bed. This opinion we opposed by as stoutly maintaining that the strata of lava forming basalt had originally been under the limestone, at present on the surface, and that the basalt showed itself, as it is now, by the upheavings of the limestone masses subsequently ; each maintaining his opinion we retraced our path to the town, Mr. Hall stated that there were very distinct evidences of volcanic action about four or five miles from Castleton, on the road to Middleton, from whence it is probable this basalt originated. We now de-

**terminated to visit the mouldering walls of the
PEAK CASTLE,**

The last object of note worthy of inspection in the neighbourhood, and this only from its romantic situation and great antiquity. Mr. Hall could not easily join us in the ascent, but waited our return at the Inn; it was with no little difficulty we gained the summit, but once there the beautiful prospect richly repaid the toil. This place, once of great strength, now lies scattered about in detached fragments; the parts best preserved are the Keep and that part of the walls overlooking the Devil's Cave; from this frightful and dizzy height we could not but call to mind the time when some powerful feudal lord held the law of power in his hand, perhaps dragging some miserable serf to the brink of this awful precipice and dashing him down headlong into the yawning abyss below. There are three views particularly deserving of notice from these ruins. The one just mentioned over the cave, the second from the Keep into Cave Dale, and the third looking over the town of Castleton and the rich valley beyond it. The antiquity of these ruins is considerable, their structure being decidedly Norman, supposed to be built by William Peveril, natural son of William the Conqueror, and is entered in the doomsday

survey as "Castle of Peke." The elevated situation of this fortress, the almost inaccessible rocks on which it is built, must in early times have rendered it impregnable. There does not appear to be any communicating passage between the Castle and the Cave beneath, which at first sight appears so probable. On the route from Castleton we did not feel any curiosity to visit

ELDON HOLE,

Its claims to investigation being trifling when compared to those spoken of already, and the difficulty of access being greater in proportion than its internal interest, we declined paying it a visit. There is no doubt but the same dreadful convulsion produced the whole of these caves, and the tale of the old woman's goose going in at Eldon and coming out at Castleton, *though a fiction*, illustrates the fact that the same stream passes through all these caves.

THE EBBING AND FLOWING WELL,

So long looked upon as a scene of magic power, and the equally absurd idea of its connexion with the ocean's tides, has now lost its claim to novelty, and is only visited by those too ignorant to allow truth to reign. The well is simply one with a syphon outlet. In wet sea-

sons the internal cavity is speedily filled by filtration from the superincumbent rock and then as speedily flows off, so as to discharge its waters frequently in twenty-four hours; in dry seasons a considerable time is required to accomplish the same; hence arises the extacy of some visitors in seeing the flood pour out and suddenly stop, while others have waited hours for the phenomena without seeing it and have gone away with the idea of a hoax. Such are the wonders of the neighbourhood of Castleton. A short ride brought me and my friend out of the beauties of Derbyshire into the plainer landscapes of Cheshire and Lancashire, where the bustle of men and manufacturies caused a sigh of regret for the bold and romantic scenery we had left behind us.

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CORRIGENDA.

Page 143, for Middleton read Tideswell.

FINIS.

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